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As to Substitute Ties

RAILWAY men are accused not infrequently of a total lack of enterprise and foresight because of their seeming inability to absorb the enthusiasm for substitute ties to which they are exposed while listening to the glittering claims made by the advocates and inventors of divers designs. Whether or not this indictment is a just one, it should be clear to any fair-minded individual that the Committee on Ties has manifested a high degree of impartiality in its perennial reports on substitute ties. The facts are presented without prejudice, and its reports, taken collectively, constitute a most comprehensive treatise on the entire subject. If inventors would take the trouble to study these reports with an open mind, they would be spared many of the disappointments and heartaches that have been the lot of those who have endeavored to win fame and fortune in this field of endeavor.

A Well Earned Reputation

NO better evidence of the standing of the A. R. E. A. in the field of applied science is to be had than that which is afforded by the frequency with which it is invited to participate in technical projects of a co-operative nature. As pointed out in Secretary Fritch's report, the association is taking a part in no less than 13 such joint activities, ranging in character from the study of rail, with the Technical Committee of Rail Manufacturers to the standardization of units of measure through the agency of the International Committee on Weights and Measures. In some instances, these invitations come by reason of the status of the association as the official organization on railway engineering, but in others, it can be explained only by the high standing which the association and its individual members enjoy in a wide range of engineering subjects. A good example of this form of participation is offered by the co-operation of the association in the tests conducted on the Yadkin river bridge, a concrete highway structure. While railroads build many concrete bridges, the call in this investigation was purely for technical knowledge of a high order, and but for the fact that the personnel of the A. R. E. A. was known to include such talent, there was no occasion for inviting the association to participate.

A Welcome New Report

FROM the earliest days, the rivers of the country have been wont to go on seasonal rampages, and experience has shown that they have been no respecters of the railways. Much has been learned about river bank protection and flood control, but owing to the magnitude of the problem and the widespread devastation from

floods, there is still much to be learned. Few realize this more acutely than those who have given the subject the greatest study. The devastating floods in New England and in the Mississippi valley in 1927 were a great impetus to further research and study of the problem of flood control, which promises to have a far-reaching effect. The latest effort in this regard is the work of the new Committee on Rivers and Harbors, which makes its first report this year. Contrary to the general belief, a large number of railways have a vital interest in a wide range of subjects which might well come under the jurisdiction of this committee, not the least of which are the important subjects of river bank protection and the construction, protection and maintenance of levees, upon which report was made this year. While the committee makes no pretense to either complete study or a final report, it has made a generous contribution toward the more effective solution of these problems, and particularly, as they are confronted continually by a number of railways. The committee's work will go on, and it is expected confidently that much good will result from its studies and findings from year to year.

Keeping in Step with Progress

THE elimination of waste, through simplification and standardization, has been one of the outstanding developments of the last decade. It is here that the engineer is in a position to play a most vital part in the efficient production of transportation. The Committee on Design of the Signal Section has repeatedly demonstrated that it is fully conscious of its opportunities for service and of its responsibilities to the railroads. This year the committee has continued its efforts in this direction and through the submission of eight revisions of standards, six new designs of equipment parts, and the removal from the Manual of eight obsolete drawings, it has taken a long step forward. Only by constant and intelligent efforts directed toward improvements in equipment standards will the signaling facilities of the railroads be able to perform their function effectively and economically.

Secretary Fritch to Japan

THE Board of Direction of the American Railway Engineering Association did a very graceful thing, and one which will meet with the general approval of the members at large, when it accepted the invitation to be represented officially at the engineering congress at Tokio, Japan, next fall, and then selected Secretary E. H. Fritch as the representative. This congress has attracted a great deal of attention and bids fair to be an event of more than ordinary importance in engineering circles. It is fitting, therefore, that the A. R. E. A. should be represented there, particularly since it has long enrolled in its membership a number of engineering officers of the Japanese and other far eastern railways. Of equal interest, however, is the significance of this action as a tribute to the long and efficient service of Mr. Fritch. Since 1906 he has labored for the organization and to him is due no small part of the credit for its present high standing. It is an interesting coincidence that, by reason of his correspondence with Japanese members of the association and occasional contact with them during their visits to this country, he has long had a desire to visit Japan and to see these members in their home surroundings. This opportunity is now to be his. The members of the A. R. E. A. will take a keener interest in the Tokio congress because of the fact that Secretary Fritch is their representative.

Prevent Confusion in Highway Crossing Signals

AT the annual convention of the Signal Section, A. R. A., in March, 1925, the Committee on Highway Crossing Protection presented a specification for automatic highway crossing signals which was later adopted by letter ballot and approved by the American Railway Association. This specification authorized an aspect reading: "When indicating the approach of a train, the appearance of a horizontal swinging red light and/or disc." In brief, this included either the alternate flashing-light signal or the wig-wag type. In view of the fact that these two types of signals have been installed extensively, further standardization may not be practicable at this time, but, if they can be used effectively to exclude other types of such signals from the field, either the flashing-light or the wig-wag will survive as the one standard. This, of course, does not include the automatic gate. So far so good, for the indication of a flashing-light crossing signal is so nearly similar to that of a wig-wag that the vast majority of highway drivers are fast becoming acquainted with the fact that such an indication designates the location of a track on which a train is approaching.

One of the fundamental differences between automatic block signals, as used for the direction of trains, and automatic highway grade crossing signals for warning traffic of the approach of a train, is the fact that the block signals give indications to direct trains to proceed or to stop, according to the condition of the block ahead, whereas the ordinary highway signal gives a warning when a train is approaching, but gives no indication advising the automobile driver that the track is clear other than the fact that no indication exists. The railroad provides the fixed cross-buck sign to designate the location of a railroad track, and the automatic crossing signal gives warning when a train is approaching. With this information, the automobile driver is expected to exercise caution to see for himself that the way is clear before proceeding across the track.

An important part of the work of the Committee on Highway Crossing Protection of the Signal Section, A. R. A., is to work toward standardization, and the major portion of the report presented by this committee at the convention yesterday was devoted to facts tending to prove that the so-called "traffic type" of signal, incorporating the red for "stop" and green for "go," was not to be recommended for automatic highway crossing signals. The committee's efforts in this direction are no idle gestures, for certain cities have encouraged the railroads to install as crossng signals, the same type of "stop and go" lights as are used at street intersections throughout the city. One road has gone further and voluntarily installed such signals at crossings outside of municipalities. The State of Minnesota has adopted a rotating disk type of signal with which is used the Signal Section, A. R. A., flashing-light signal, while other states and certain municipalities have required an illuminated "STOP" sign to be used with the standard flashing-light signal.

The use of the "traffic type" signals, as well as the various accessory signs, all tend to reduce the effective-

ness of the committee's work to maintain a standard indication for crossing signals that means only one thing to an automobile driver on the highway, i. e., the location of a railroad track on which a train is approaching. The committee is to be commended for its persistent efforts and deserves the co-operation of all railroad officers in working towards the goal of standardization.

Railway Sanitation

BY action of the board of direction of the A. R. E. A., the work of the Water Service Committee has been enlarged to embrace railway sanitation. Heretofore, the attention of the A. R. E. A. has practically been limited to the general subject of drinking water, in connection with which the committee has prepared reports on the care and handling of water supplies from this standpoint and has represented the association on a joint committee of the A. R. A. in following the Federal Health Regulations governing Interstate Commerce. Other questions of sanitation have been largely ignored or left to chance consideration in the association's work. The interpretation placed upon the expansion of the Water Service Committee's jurisdiction is that railway sanitation will now receive more detailed attention.

This committee is ordinarily supposed to be interested only in water supply questions, but the understanding is that its study of sanitation is to be broader than that. Thus, what the A. R. E. A. has done in effect is to establish a special committee on sanitation without enlarging the number of committees. While the union of water service with sanitation may not be a perfect one and may need revision later, the action to study railway sanitation more specifically is salutary.

In railway service, the importance of sanitation work should be considered comparable to that of safety work. Safety work is concerned with the prevention of accidents; sanitation is directed to the improvement and conservation of health. The railways have become greatly interested in safety work and now make a specialty of following it from both humanitarian and economic reasons. They should become actively interested in railway sanitation for identical reasons. If it is a good policy for a corporation, in dealing with labor, to protect its workmen and their families from accident, it is an equally good policy, in dealing with labor, to protect employees from illness caused or prolonged by unhealthy conditions. Correspondingly, if it is a good economic policy to avoid accidents to employees and the public and thus eliminate the costs and losses that grow out of accidents, it is equally advisable to protect the public and employees from illness, not only that illness which takes an employee from his work, but also those bodily indispositions which impair his efficiency while engaged in his work.

The Spanish-American war taught this country the need of sanitation, and the campaign against yellow fever in constructing the Panama canal afforded the classical example of its worth. In malaria control, the railways have been given many examples of the possibilities in applying sanitation, but the full benefits cannot be accomplished until the principles of sanitation are thoroughly known and consistently applied. The work of the A. R. E. A., with its proposal to give detailed and systematic attention to sanitary matters as they affect the construction, maintenance and operation of the railway properties, is a worthy undertaking and should bear much fruit.

The A.R.E.A. Program

The convention will be called to order promptly at 9 o'clock this morning. The afternoon session is scheduled to convene at 2 o'clock. The program is as follows:

TODAY

Rules and Organization
Yards and Terminals
Rivers and Harbors
Wood Preservation
Stresses in Railroad Track
Address by Major-General Edgar Jadwin
Chief of Engineers, United States Army
Grade Crossings
Track
Electricity
Signals and Interlocking
Annual Dinner
Grand Ballroom, Palmer House, 6:30 p. m.

TOMORROW

Iron and Steel Structures
Wooden Bridges and Trestles
Masonry
Records and Accounts
Buildings
Address by O. H. Caldwell, Esq.
Member, Federal Radio Commission
Rail
Economics of Railway Location
Economics of Railway Operation
Economics of Railway Labor
New Business
Installation of Officers
Adjournment

Announcements

Greetings and Salutations

The list of those who sent their greetings to the convention is particularly imposing this year and includes Ex-President Coolidge, Charles E. Mitchell, president of the National City Bank of New York, Ernest I. Lewis, chairman of the Interstate Commerce Commission, and Charles M. Schwab, chairman of the Bethlehem Steel Company.

A Russian Buyer

M. I. Vakhnin, director of railways signalization laboratory and four other officers of the Russian railways at Leningrad are making their first appearance at the conventions incident to a several months' visit in this country for the purpose of buying American supplies, chiefly signaling supplies, for the Russian railways. Those attending the convention will find cause for an increased interest in the exhibit of railway appliances being held in conjunction with the convention in the statement of Mr. Vakhnin that while a museum of appliances is maintained in Russia at Leningrad, this museum is purely of an historical character and affords railway officers no means of seeing the up-to-the-minute devices and appliances adapted to railway purposes. It is largely because of this deficiency that Russian railway men must go abroad to learn of the latest developments in the art of transportation. Mr. Vakhnin is stopping at the Roosevelt.

CONVENTIONALITIES

Chicago alumni of Purdue university are holding a luncheon today at the Chicago Engineers' Club at 12:30 p. m. All visiting alumni who wish to yell: "Bully for old Purdue," are invited to attend.

The feminine touch was present again at the convention yesterday. Miss Olive W. Dennis of the engineering department of the Baltimore & Ohio is attending her second A. R. E. A. convention and is rapidly becoming an enthusiastic member.

F. J. Stimson, treasurer of the association and chairman of the Committee on Grade Crossings and also assistant chief engineer of the Pennsylvania System, Northwest Region, is unavoidably absent from the meeting this year. Mr. Stimson suffered a stroke last summer and while he is on the road to recovery his progress has not been sufficient to permit him to attend the meeting.

For Sale—Christmas Cards

Bob Sheets, assistant signal engineer of the Chicago & North Western, has a large supply of slightly used Christmas cards, all of which (except the "Scotch" cards) are for sale. Bob says he acquired all these cards because a number of his friends sent him one every week for six months.

The Peppy Water Service Committee

The traditional luncheon of the committee on Water Service has become an established convention feature.

The Water Service Committee Drinks Water

The boys turn out in large numbers, as is evidenced by the accompanying illustration of one of their luncheons in the Palmer House. Thirty or more of the water men are always present, under the genial leadership of C. R. (Dick) Knowles.

David White, sales engineer for the Roberts & Schaefer Company, was called away from the exhibit at the Coliseum yesterday by the death of his small daughter, after an extended illness at his suburban home in La-Grange, Ill.

Pronounced interest is being shown by all visitors at the A. R. E. A. convention in the exhibit being shown at the Palmer House, of the surveying instruments used on the Cascade tunnel project. These embrace three direction instruments employed by the Great Northern field parties in the triangulation work necessary for the projection of the tunnel center line from the two portals and the Mill Creek shaft.

E. L. Sinclair, division engineer of the Iowa division of the Chicago, Milwaukee, St. Paul & Pacific with headquarters at Marion, Iowa, died suddenly last Thursday, February 28, from a cerebral hemorrhage. He was apparently in the best of health the preceding day, having handled his accustomed work, but died during the night, being found dead in bed the following morning.

Drill, Ye Terriers, Drill!

The Chicago section of the Society of American Military Engineers will entertain Major General Edgar Jadwin, chief of engineers, United States Army, at a luncheon in the Red Lacquer room of the Palmer House today. All members and guests who possess the requisite $1.50 are invited to attend. General Jadwin will speak at this morning's session of the A. R. E. A.

Eight Members Step Along

They have a saying on the Illinois Central that when a new president or vice-president is appointed, the effect is felt step by step down the line until the vacancy is filled by the appointment of a new telegraph operator or track man. This was confirmed last week when, following the election of A. E. Clift, senior vice-president of the I. C. as president of the Central of Jeorgia, succeeding J. J. Pelley (also an I. C. product), when a number of changes were made. J. W. Kern, Jr., district engineer at New Orleans was promoted to superintendent of the Springfield division, J. E. Fanning, district engineer, Western lines was transferred to New Orleans to replace Mr. Kern, G. M. O'Rourke, roadmaster, St. Louis division was promoted to district engineer, Western lines to succeed Mr. Fanning, W. R. Gillam, roadmaster at Clinton was transferred to Carbondale to replace Mr. O'Rourke and H. C. Hayes, assistant roadmaster on the Chicago Terminal division was promoted to roadmaster at Clinton. Thus one vacancy led to the promotion of eight members of the A. R. E. A.

The Pennsylvania has just authorized the installation of visual audible cab signaling on its main line between Philadelphia and Washington at a cost of $1,700,000.

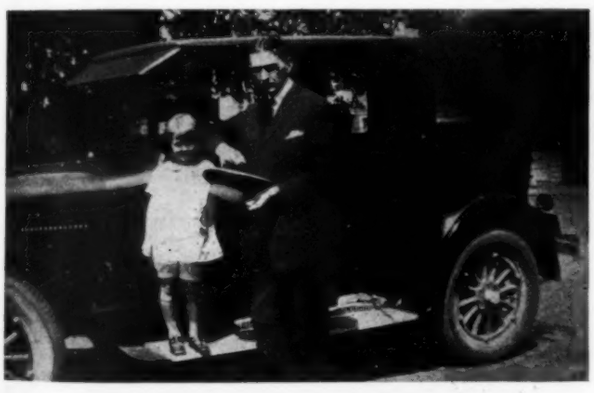
It will be remembered that Secretary Balliet was unable to attend last year's meeting because of the serious illness of his wife, who has been in poor health for some years past. This year, Mrs. Balliet's health is so much improved that she was able to attend President Hoover's inauguration in Washington.

Eugene Keller, Jr., who has recently been appointed manager of the railroad department of the Philip Carey Company, Cincinnati, Ohio, is now in charge of the exhibit of that company at the Coliseum for the first time. Mr. Keller, however, has been associated with the Carey Company for the last five years, having previously engaged in railway engineering and construction work.

W. N. Manuel of the Corning Glass Works, Corning, N. Y., and chairman of the Signal Appliance Association recently acquired a police dog, but Bill is away from home so much that the dog has refused to recognize him as a member of the Manuel household. Bill is now in a quandary as to whether to continue west from Chicago or to get himself some special protection against the dog and return home.

Mr. Faucette and a Certain Young Lady

Being president of the A. R. E. A. is a source of great pride to W. D. Faucette, chief engineer of the Seaboard Air Line. But that is by no means his only source of pride, as is evidenced by the accompanying



President Faucette and His Girl Friend

illustration. The lovely Southern lass on the running board is none other than Miss Belle Faucette, youngest daughter of our president. And don't believe that she isn't proud of papa, too.

Mr. McDonald's Travels

Hunter McDonald, chief engineer of the Nashville, Chattanooga & St. Louis, and a past president of the A. R. E. A., has indulged in a round-the-world tour in the past year. That he has not forgotten the association and vice versa was indicated last summer just before he sailed for Honolulu, when he attended a luncheon in San Francisco at which were present Messrs. Kirkbride, Harding and Campbell, of the Southern Pacific and of the Committee on Rail.

The Boston & Maine has just announced plans for the construction of a 500-room hotel connecting with its new North station at Boston, Mass., to cost about two and a half million dollars.

Japan has sent two representatives to the convention this year. J. Ezawa is chief engineer of the Yokohama Improvement Section, Department of Railways, with headquarters at Yokohama, and H. Aoyama is engineer maintenance of way, Japanese Government Railways, Tokyo.

Committee No. 4—Rules—of the American Association of Railroad Superintendents met in the Hotel Stevens Monday, with eight members present, to formulate its report for presentation at the convention at Mexico City next June. This committee works jointly with the Signal Section, A. R. A., in the study of the use of signal equipment to facilitate train operation and its meeting yesterday was scheduled to enable the members to attend the signal convention.

From the Far East

The usual foreign representation is here this year. In this connection, we reproduce an informal gathering consisting of D. J. Brumley of the Illinois Central and

From Right to Left: Messrs. Brumley, Yager, and Maksumara and Tai, Far Eastern Members, With an Unidentified Associate

Louis Yager of the Northern Pacific, in deep discussion with members of the Far East contingent, including K. Tai, of Yokohoma, technical chief of the Imperial Government Railways, and T. Maksumara, of Sendai, chief engineer of the East Indian railway system.

Now It Can Be Told

It will be remembered that President Faucette was presented with a large and handsome banjo clock last year. On his way home, he permitted no one to touch it until he reached Savannah. There he entrusted it to an old red-cap, whom he knew to be reliable. The old negro took exceedingly good care of his precious burden, but it kept slipping and caused him a lot of annoyance getting it to the automobile. As he deposited it in the back seat, he heaved a sigh of relief. Then, turning to Mr. Faucette, he said:

"Boss, wouldn't it be handier if you wore a wrist watch?"

Myron B. Atwood, president of the Western Wheeled Scraper Company, Aurora, Ill., died in that city on February 26 after a lingering illness. He had been connected with this company since 1906 when he became assistant engineer. He was promoted to general manager in 1910 and was elected president and general manager in 1925.

In spite of the ruddy appearance of Louis Yager, vice-president of the A. R. E. A., it may not generally be known that he was seriously if not critically ill for a large part of last Spring and Summer from a chronic anaemic condition. He was in the hands of specialists of the Twin Cities and was a guest of Mayo Brothers at Rochester, Minn., for some time, with the result that he is now entirely recovered and ready for a hard year's work.

F. B. Weigand, signal engineer, New York Central, together with Fred Jones of the Page Steel & Wire Company and Jack Wills of the General Railway Signal Company, recently took an airplane trip from Cleveland to Detroit, riding along some 3,000 ft. over Lake Erie. For some reason or other Fred Weigand fell asleep on this trip and, when questioned closely on this subject, he claimed that the smooth riding of the Lake Level Route was nearly equal to that of the Water Level Route and therefore lulled him to sleep.

A feature of Monday night's dinner of the Signal Appliance Association at the Stevens Hotel was the "Old Timers' Table," to which were assigned:

Milt Baird, Erie.
H. S. Balliet, New York Central.
W. H. Elliott, New York Central.
W. G. Gillingham, Union Switch & Signal Company.
Charles Kelloway, Atlantic Coast Line.
J. C. Mock, Michigan Central.
Charles Morrison, New York, New Haven & Hartford.
A. H. Rudd, Pennsylvania.
Thomas Stevens, Atchison, Topeka & Santa Fe.
A. H. Yocum, Reading.

Despite its name, this table was particularly conspicuous for its "pep."

Hudson Bay Railway Nearing Completion

The end of the track on the Hudson Bay Railway is now within 15 miles of Churchill, the northern terminus of this line on Hudson bay, according to H. A. Dixon, chief engineer of the Canadian National, Western Lines, who registered at the convention yesterday morning. We expect, he said, that rail laying will be completed in Churchill not later than April 15. The construction forces made commendable progress during the past winter in spite of extreme temperatures and a number of severe blizzards.

A Hard Worker

There are a certain number of members that one naturally thinks of when the A. R. E. A. is mentioned. Among these is W. C. Cushing, engineer of standards, Pennsylvania, a charter member, now sixth on the list. In the 29 years of the association's existence, Mr. Cushing has done just about everything in connection with the association. He was a director from 1906 to 1908, and served as president in 1911. He has been a member of the committee on Rail since 1908, and was chairman of that committee in 1913. He has been a member of the special committee on Stresses in Track since 1912, and has been chairman of the Committee on Standardization since 1926.

C. A. Christofferson, signal engineer, Northern Pacific, had to hurry home Tuesday to get started on the installation of 42 miles of color-light automatic block signals, between Tacoma, Wash., and Tenino, authority for which has just been granted.

One of the largest bridge construction contracts announced in recent years is that which the Southern Pacific has just awarded for the building of a bridge over Suisun Bay near Martinez, Cal. Siems, Helmers & Shaffner, Inc., St. Paul, Minn., was the successful bidder for the foundation work and the American Bridge Company for the superstructure. This bridge will cost approximately $12,000,000.

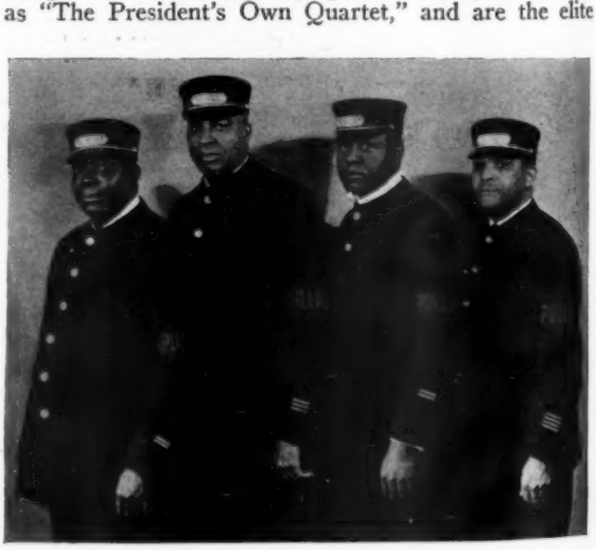
The members of the Executive Committee of the Roadmasters Association, together with the chairman of standing committees, had dinner together in the Palmer House last night for the purpose of reviewing current affairs of the association and in particular the progress being made in the preparation of committee reports to be presented at the convention to be held in Chicago. President H. R. Clarke, general inspector of permanent way of the Burlington, presided and reported that he was well pleased with the progress being made.

Tough Luck, Alex

Alexander Chapman, manager of the Rail Joint Company, Chicago, planned an extensive business trip through the south during January. Prior to leaving, Alex spent several days laying in supplies for the well known game of golf. The tragedy of the whole affair is that in his rush to catch the train the entire golf outfit was left behind at the Chicago Union Station.

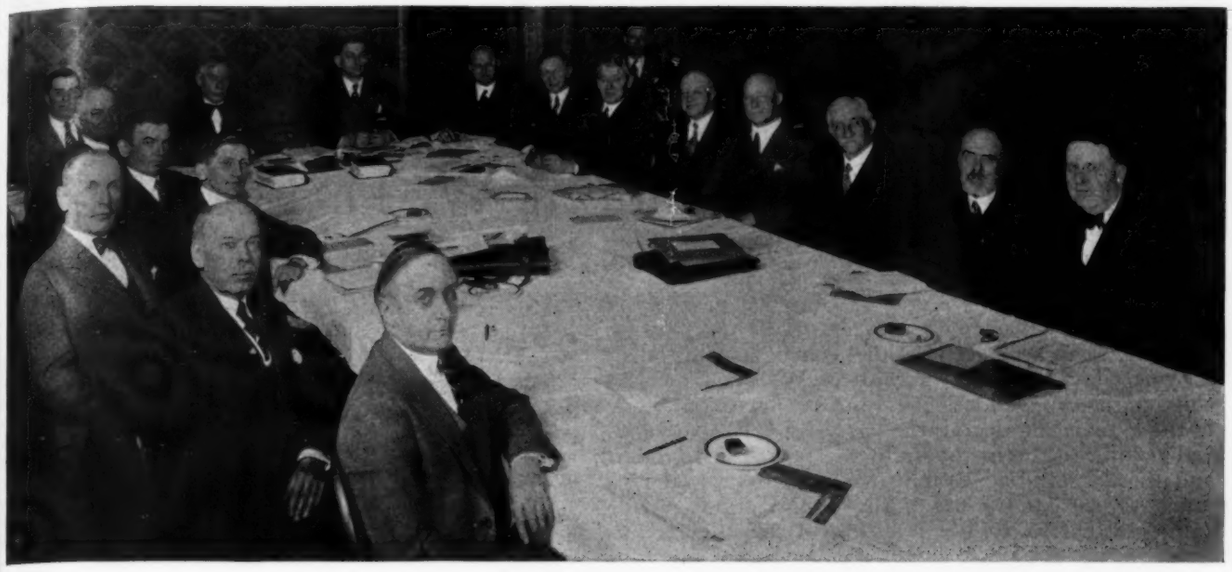
Close Harmony

The Pullman boys who will sing to us at the banquet tonight are "something very special." They are known as "The President's Own Quartet," and are the elite



The Picked Quartet of Pullman Porters

of all Pullman porter quartets. Their rendition of old negro spirituals is something not to be missed. If you have not yet secured your tickets, you had better attend to this at once.



The A. R. E. A. Board of Direction Was in Session All Day Monday

Reading around the table from left to right: F. E. Morrow, Robert H. Ford, J. L. Campbell, John V. Neubert, George J. Ray, E. H. Lee, Frank McNallis (Secretary's office), E. H. Fritch, W. D. Faucette, Louis Yager, G. D. Brooke, D. J. Brumley, Hadley Baldwin, Arthur Montzheimer, Dr. A. N. Talbot, Chas. H. Churchill, J. E. Armstrong.

A. R. E. A. Convenes at Chicago for the Thirtieth Time

The reports of 9 committees were presented and discussed at yesterday's sessions

MESSAGES of greeting from Ex-President Coolidge and Chairman Lewis of the Interstate Commerce Commission, and letters to President W. D. Faucette from Charles E. Mitchell, president of the National City Bank of New York, and from Charles M. Schwab, chairman of the board of the Bethlehem Steel Company, were read at the opening of the thirteenth annual convention of the American Railway Engineering Association yesterday morning. The grand ballroom of the Palmer House was well filled when the president called the first session to order at 9:35. The members began to gather in the spacious foyer on the fourth floor at 8:30 and in a short time a large crowd had collected, a well organized reception committee functioning effectively in promoting prompt registration. However, owing to the exceptional opportunities afforded for exchanges of greetings and the renewal of acquaintances it was with some difficulty that the members of the Committee on Arrangements prevailed on those present to pass into the convention halll at the appointed time.

Secretary Fritch Reviews His Report

After the reading of the president's address, which appears on the next page, Secretary E. H. Fritch briefly sketched the contents of his annual report as a means of conserving time, following which the president called the Committee on Standardization to the platform to present its report. At the conclusion of this report the Committee on Water Service and Sanitation was called to the platform and made an extended presentation. In closing the discussion of this report President Faucette commended the committee heartily for its work and particularly for the large attendance, more than thirty members being present on the platform. The Committee on Roadway was then called to the platform and presented a portion of its report, but at 12 o'clock its work was interrupted to permit C. R. Harding, engineer of standards of the Southern Pacific, to give an illustrated talk on the plans for the Suisun Bay bridge which is to be built to eliminate the Carquinez Straits ferry service on the Southern Pacific's overland route into San Francisco.

Discusses Economic Aspects

Mr. Harding's paper was devoted in part to an explanation of the economic and practical considerations which led the management of the Southern Pacific to undertake this prorject, which will involve an expenditure of about $12,000,000. Primary among these is the serious limitation placed on the capacity of the line through the delays incurred in the ferry transfer of trains. He also discussed the engineering problems presented in determining the primary dimensions of the bridge structure, as influenced by navigation requirements and other considerations. This paper will be presented in full in the regular weekly issue of the *Railway Age* of March 9.

Following Mr. Harding's paper, the convention adjourned for lunch. When it reconvened at 2 p. m. the Roadway committee returned to the platform and completed the presentation of its report, following which the report of the Committee on Ballast was offered. The Committee on Ties was then called to the platform and the discussion of its report occupied the greater part of the afternoon. At the conclusion of this, the Committees on Uniform General Contract Forms, Shops and Locomotive Terminals, Clearances and Co-opera-

tive Relations with Universities presented their reports in turn, the latter being supplemented by a written report presented by W. C. Cushing (Penna.) in which he outlined a plan for the promotion of co-operation between railroads and the colleges for the education of employees.

Address of President W. D. Faucette

Reviews work of the association and emphasizes the need of economical studies to meet new competition

SHORTLY after calling the convention to order yesterday morning, President W. D. Faucette, chief engineer, Seaboard Air Line, reviewed the work of the association during the past year. He paid special tribute to the members of the board of direction and the 28 standing committees who have given so much time to the work of the organization. After calling attention to the addition of 325 new members during the year he emphasized the value of membership in the organization. He then spoke at length on the future of the association and of the problems concerning it in part as follows:

It is with great difficulty that we attempt to vision the future. Since 1890 the marked increase in all lines of industrial, scientific and transportation activities is probably without parallel in the history of the world. These 40 years have witnessed such achievements that if we attempt to project outselves into the future, I do not believe that we can reasonably forecast where we will reach and what will be our experiences.

Insofar as progress in the world of transportation shall continue, so also shall the responsibilities of our association increase, and the solution of problems of economics will become more pressing. In this time, which we must acknowledge to be a period of transition, it is of paramount importance that the efforts of ours and allied associations should be directed towards the effecting of economies and the solution of problems which will enable us, as an agency of transportation, to say what will help produce—a service satisfactory and economical, which production shall bring a reasonable return to the owner. This one idea shall ever be before us in searching for the proper answers.

It will not be amiss to touch briefly upon the motor transportation of this country, and the increasing air transportation efforts. So far as heavy tonnage movement is concerned, I believe that we can defer consideration for the present of the possibility of air transport having much adverse effect upon the main revenues of our railroads. I fully believe that, with the remarkable records that are being made month by month, the field of quick transport by air will be confined chiefly to those articles of high intrinsic value, such as mail, securities, small but important parcels, and human freight, but not of large weight. This will tend to prevent the air transportation service from making as great inroads in the business of trunk line carriers as have been brought about through the present and ever-increasing motor transport operations. This problem of motor transport is not a matter of reckoning with an organization in the sense of an opposing competitor, or group of competitors. We have reached a place in our civilization where a new instrumentality has become a part of our life—it has changed business, social and civic customs and created a changed condition. It is a fact and not a theory.

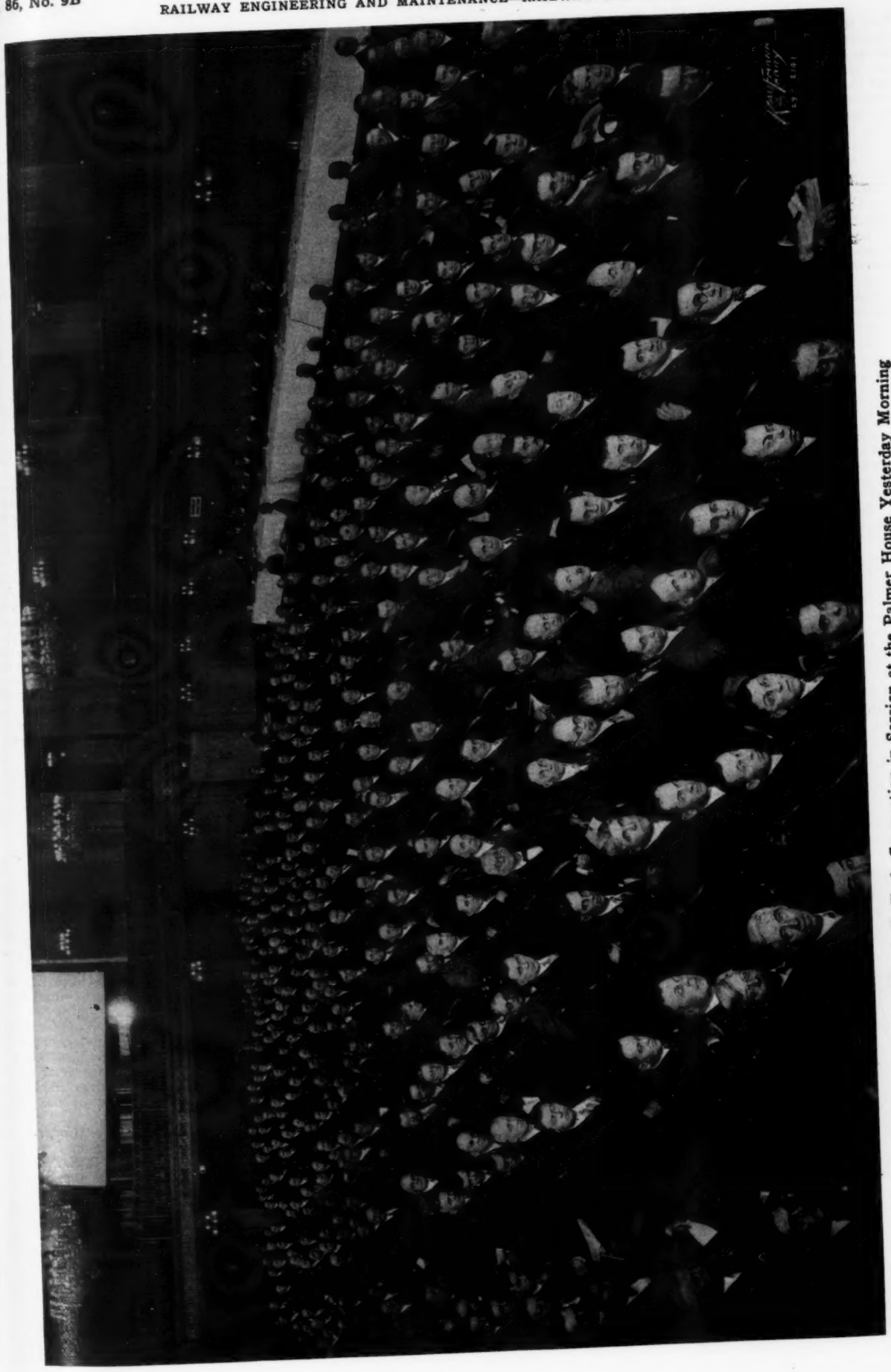
This impetus to public roads, which is now in but the middle stages of progress, has effected adversely the revenues of our rail carriers, and thereby imposed upon us most seriously, the importance of a proper solution of problems of economics in order that we may carry on and render service economically. I dare say that there is hardly one within the sound of my voice who is not impressed with the growth of the motor industry. Statistics are, at best, a burden, but in 1921, in round numbers, there were 10 million motor vehicles registered in the United States. In two years this went to 15 million and in four years more, it reached 23 million, so that at the present time there is one motor vehicle for about every five persons. (In this list were about three million motor trucks and road tractors and 125,000 trailers). In 1928 we produced one million more passenger automobiles than in 1927.

Parallel with this is the question of public roads. In 1918 we had about 300,000 miles of surfaced county and rural roads. In 1928 this was 590,000, of which nearly 100,000 miles are hard surfaced, and there is a co-ordinated national system of Federal Aid roads, aggregating 188,000 miles. The state highway systems total about 295,000 miles and interstate marked systems nearly 97,000 miles. The total mileage of our rural roads of all classes, is about 3,000,000. In the last ten years some six billion dollars have been spent on them, and we cannot diminish the excellence of the state and federal highway systems that are being constructed. In the Southeast alone, it is interesting to point out that the State of North Carolina has spent approximately $150,000,000 in the last few years on a carefully worked out system of highways.

In the broadest aspect of the case, engineering is but science applied to industry. We are seeing developed be-

W. D. Faucette
President

In the election of Mr. Faucette to the presidency, the A. R. E. A. conferred distinct recognition on a southern railroad, the Seaboard Air Line, for he is distinctly a product of that property, having been employed exclusively on that road since he graduated from North Carolina State College of Agriculture and Engineering in 1901. It is worthy of note that he became chief engineer after less than 12 years' service. Mr. Faucette has been a loyal member of the association and has labored earnestly on committee assignments. He is identified in particular for his work in the Committee on Uniform General Contract Forms, covering a period of 10 years.



The A. R. E. A. Convention in Session at the Palmer House Yesterday Morning

fore us in strides without parallel in the history of human achievement, the construction of roads and the building of motor vehicles. This is an interesting problem inasmuch as the construction of roads encourages the production of vehicles and the vehicles in turn encourage the increase in road mileage. Transportation by these new arteries of commerce will, in time, call for proper and just regulation and co-ordination. Undoubtedly, with a better knowledge of the situation, both with respect to taxation and maintenance and with whatever effect it may have upon great rail transportation lines, reasonable regulations will come about. However, if the growth in this industry is as great in the future as it has been in the past (and it will probably be large) the inroads made by taking for transport the tonnage of these vast rail carriers will be of such as will call for the best brains and talent of this country. At the present time in many localities the short haul freight and passenger rail movement is diminishing rapidly. The rail lines must study more intensely the problems of economics to meet the heavy inroads made by these motor instrumentalities. This association cannot escape and does not shirk the duty of such study as may be necessary to meet the reduced tonnage and the competition affected by this vast system of interstate highways.

But with this picture of this great highway transportation system being developed while rail workers look on, our business still justifies engineering improvements, and marked accomplishments have been made. While it is impossible to go into details in this large country of ours, it is but right that we should record certain important construction items in railroad and allied work in the last year or two. Let me not forget to direct attention to the Cascade tunnel on the Great Northern, and to the Moffat tunnel in Colorado, the first being nearly eight miles long and the longest in America, the second over six miles long. Other important projects include the electrification of certain parts of the Great Northern, the Pennsylvania, the Lackawanna, the Reading, the New York Central and others. New and modern railroad bridges are under construction by the Chesapeake & Ohio and the Big Four, the combined highway-railroad bridge at Vicksburg, Miss., and the "Suisun Bridge" of the Southern Pacific in California. Grade revision and double track work, such as undertaken on the Missouri Pacific and other roads, and some projects for extensive union passenger terminals in important centers are under construction. Automatic signals were installed on about 3,100 miles of road in 1928. It has been forecast that in 1929 more new money will be spent on our railway systems than in 1928.

Huge capital expenditures have been made in the last few years. The fact that our managements have concluded to make these vast investments indicates their faith and confidence in the operating economies that are forecast by engineering studies. I think that we may safely say without qualification that no project of note is ever undertaken on any railroad until a careful analysis has been made to analyze the future results. Surely our business, that of engineering construction and maintenance, is free from the emotions of life that may, in their enthusiasm, carry us off of our feet and cause us to do those things which cool and meditated consideration would show to be an unfortunate blunder. The efforts of this association, in its study of many of the problems and subjects coming under its scope during the last 30 years, has contributed in very large measure to preventing unwise and unfortunate expenditures by the owners of our vast properties. Our work is not complete; facing the complexity and keen competition of the age, the need for thorough work by our association is just as pressing and will ever be, for with every problem there is a corresponding call for a sound conclusion.

I must refer to the transverse fissure detector car devised by the Sperry Development Company through contact with the Rail committee and with the American Railway Association. The results thus far achieved have been more than were at first anticipated and we look forward to greater results from this direction. This device marks a pronounced advance in this special subject.

Among such other work as may come within the scope of our Association, we must mention the work done by the Special Committee on Stresses in Railroad Track, the investigation of bearing values of large rollers and other related items. I cannot but believe that in research work we have yet some field in which we can proceed with justification. We may be faced in the future with questions of new rail design and improvement, a changed or modified track structure, with laboratory experiments in materials for railway construction, possibly the use of more alloys, questions of economic substitutions, and the great problem of training men for the future control and administration of railroad properties. At this time, with industrial development and progress now apparently approaching the highest peak in the history of the world, we must not overlook the problem of the proper training of men for contact with each other and for the reception of heavy responsibilities which must devolve upon them in the next 25 to 50 years. This problem has so many phases and touches so deeply the question of personality that as I look into the many avenues of intense specialization, I would put forward as of primary importance, the need for railway officers and executives to not overlook the necessity for encouraging initiative and developing talent, so as to insure that broad-minded and properly equipped administrators will evolve with the necessary wide experience to handle successfully the properties which this association in its particular sphere is attempting to build, improve, operate and maintain economically.

The Report of Secretary E. H. Fritch

E. H. Fritch
Secretary

THE principal activities of the past year are of course those of the standing and special committees, whose reports appeared in Bulletins 310-315, inclusive. Committee-work is the foundation of the association's activities. How well and thoroughly the committees have performed their duty will be apparent by reference to the subjects dealt with during the year. The volume of committee reports is materially greater than in any previous year in the association's history.

Relations with Kindred Organizations

Co-operation with organizations has been continued on matters of mutual interest. The following is a summary of such collaboration:

International Committee on Weights and Measures.—The U. S. Bureau of Standards invited the A. R. E. A. to be represented at a conference to discuss the question of an international agreement on temperature for intercomparison of industrial standards. W. C. Cushing, engineer of standards, Pennsylvania, was designated by President Faucette to serve in that capacity. The bureau announces that as a result of its investigation, it has recommended 68 deg. F. (20 deg. C.) as the best standard temperature for use in connection with industrial standards, gage blocks, etc.

War Memorial at Louvain (Belgium) University.—Dr. W. K. Hatt, professor of civil engineering, Purdue University, was delegated by President Faucette to represent A. R. E. A. at the dedication of the war memorial at the University of Louvain, in memory of American engineers who lost their lives in the World War.

Advisory Committee on Tests of a Reinforced Concrete Bridge.—President Faucette designated J. B. Hunley, engineer of bridges and structures, Cleveland, Cincinnati, Chicago & St. Louis, as member of an advisory committee for tests on a reinforced concrete bridge over the Yadkin river in North Carolina. Mr. Hunley's report on the results of the tests will appear in abstract form in a future bulletin.

Translation into Spanish of Specifications for Concrete.—The report of the Joint Committee on Specifications for Concrete and Reinforced Concrete, adopted by the A. R. E. A. at the annual meeting in 1927, has been translated into the Spanish language and published in "Ingenieria," the official monthly publication of the College of Engineering, National University of Mexico.

Tests on Bearing Values of Large Rollers.—This study has been continued at the University of Illinois, under the auspices of the Committee on Iron and Steel Structures. The experiments are being made under direction of Prof. W. M. Wilson, member of the committee. The tests are being financed principally by the American Railway Association, and in part by the Scherzer Rolling Bascule Bridge Company.

Boiler Feed Water Studies.—The Committee on Water Service and Sanitation is now assembling data in support of the

request for an appropriation by railways to conduct tests on boiler feed water. The National Electric Light Association has indicated its willingness to make a very substantial contribution to the proposed fund.

Appalachian Power Conference.—The invitation extended to the association to be represented at the above-named conference was accepted, and W. L. Morse, special engineer, New York Central; Reuben Hayes, engineer maintenance of way, Southern, and L. L. Beall, chief engineer, Atlantic, Birmingham & Coast, were designated by President Faucette to represent the association. The conference was held at Chattanooga, Tenn., on October 8 to 10, 1928.

National Fuels Meeting.—This meeting was attended by George H. Tinker, bridge engineer, New York, Chicago & St. Louis, and H. W. Fenno, engineer maintenance of way, New York Central (Lines West), as delegates from the A. R. E. A. The meeting was held at Cleveland, September 17 to 20, 1928.

Joint Committee on Railway Sanitation.—The designation of the Joint Committee on Drinking Water Supplies has been changed to the above form during the year, and its scope enlarged to cover the subjects implied in the title.

Committee on Automatic Train Control, A. R. A.—Two changes were made in the representation of the Engineering division on this Joint Committee during the year. The death of Edwin B. Katte created a vacancy, which was filled by the appointment of John V. Neubert, chief engineer maintenance of way, New York Central. H. E. Stevens, vice-president, Northern Pacific, resigned and Bernard Blum, chief engineer of the same company, was appointed to fill this vacancy.

American Committee on Electrolysis.—The Committee on Electricity is maintaining contact with this organization through three representatives—Martin Schreiber, chairman; W. M. Vandersluis, vice-chairman, and H. A. Currie.

Joint Committee on Concrete and Reinforced Concrete.—The Masonry committee is represented on this Joint committee by T. L. D. Hadwen, F. E. Schall, C. C. Westfall and J. J. Yates.

Joint Committee on Culvert Pipe.—Two members who have heretofore represented the Masonry committee on this joint body died during the year—A. F. Robinson, bridge engineer of the Atchison, Topeka & Santa Fe, and Job Tuthill, assistant chief engineer, Pere Marquette. G. A. Haggander, bridge engineer, Chicago, Burlington & Quincy, succeeded the late Mr. Robinson. A report made by the Joint Committee is incorporated in the report of the Masonry committee.

Marine Piling Investigation.—The association's representatives on this investigation, Dr. Hermann von Schrenk, chairman; Col. Wm. G. Atwood, C. S. Burt, G. F. Eberly, Andrew Gibson and W. H. Kirkbride, have continued co-operation with the Chemical Warfare Service in the study of marine piling. A progress report is included in the current report of the Committee on Wood Preservation.

American Standards Association.—The American Engineering Standards committee has changed its title to "American Standards Association" and adopted a new constitution. The report of the Committee on Standardization contains the revised constitution. W. C. Cushing, engineer of standards, Pennsylvania, represents the engineering division in that organization.

Joint Committee on Metric System of Weights and Measures.—President W. D. Faucette is chairman of this joint committee, appointed by the American Railway Association, for the purpose of keeping in touch with the developments in the efforts made by certain interests to make the use of the metric system of weights and measures compulsory in this country. John R. Leighty, W. P. Wiltsee, and M. J. J. Harrison are associated with Mr. Faucette on this joint committee.

Rail Manufacturers' Technical Committee.—Co-operation has been continued with the Technical Committee of Rail Manufacturers, through the Committee on Rail, in studying the principal causes of transverse fissue in steel rails.

Manganese Track Society.—The collaboration of the Track committee and the Manganese Track Society has been continued and has proved of mutual benefit. As a result of this co-operation, nearly 200 trackwork plans have been formulated and approved by the association.

Membership

The table below is a record of the additions, deaths, resignations, and dropped in the membership rolls during the year:

Membership as of March 1, 1928		2,607
Additions during the year	325	
Losses by death	34	
Resignations	36	
Dropped from rolls	72	142
Net gain		183
Total Membership as of March 1, 1929		2,790

Increase in Membership.—Special efforts were made in the past year to bring the membership number up to "3000" to correspond to the thirtieth annual meeting, but unfortunately this expectation was not quite realized. Through the efforts of President Faucette, and the hearty co-operation of individual members, it is gratifying to note a substantial increase over the preceding year. The association is also indebted to C. E. Johnston, president, Kansas City Southern, for securing the affiliation of approximately thirty-five members, principally railway presidents, vice-presidents, general managers, etc.

Classification of Membership.—The following table is a departmental classification of the membership:

General officers	203
Transportation officers	112
Maintenance of way and structure officers	1846
Maintenance of equipment officers	17
Traffic officers	5
Accounting officers	21
Purchasing and stores officers	4
Professors in colleges	68
Miscellaneous	514
Total	2790

Deceased Members

It is with deep regret that we record the loss of the following valued members since the last annual meeting:

H. H. Althouse, consulting engineer, Reading, Pa.

*John B. Berry, consulting engineer, Omaha, Neb.

C. G. Burnham, executive vice-president, Chicago, Burling & Quincy.

J. M. Cowsert, supervisor, water department, Missouri Pacific.

*Garrett Davis, division engineer (retired), Chicago, Rock Island & Pacific.

*Paul Didier, principal assistant engineer, Baltimore & Ohio.

Howard Elliott, chairman of board, Northern Pacific.

W. J. Gooding, division engineer, Seaboard Air Line.

C. S. Henning, construction engineer, Southern Pacific.

G. H. Hicks, chief engineer, Northwestern Pacific.

A. P. Himes, assistant engineer, New York, Chicago & St. Louis.

J. M. Hoar, assistant engineer, Illinois Central.

C. A. Hornecker, supervisor bridges and buildings, Missouri Pacific.

R. H. Howard, chief engineer, Wabash.

Richard L. Humphrey, consulting engineer, Philadelphia, Pa.

D. B. Johnston, division engineer, Pennsylvania.

Edwin B. Katte, chief engineer, electric traction, New York Central.

*Howard G. Kelley *(past-president)*, former president, Grand Trunk System.

J. A. Killian, engineer maintenance of way, Southern Railway.

W. P. Kritzer, resident engineer, Chesapeake & Ohio.

C. M. Larsen, chief engineer, Wisconsin Railroad Commission.

F. D. Nauman, engineer maintenance of way, Oregon Short Line.

R. S. Parsons, chief engineer, Erie.

E. J. Pearson, president, New York, New Haven & Hartford.

J. H. Reagan, superintendent track, Grand Trunk Western Railway.

Albert F. Robinson, bridge engineer, Atchison, Topeka & Santa Fe System.

L. O. Sloggett, field engineer, terminal improvements, Illinois Central.

W. T. Spencer, superintendent, New York, New Haven & Hartford.

J. A. Spielmann, assistant general superintendent, Baltimore and Ohio.

J. E. Turk, retired general superintendent, Reading.

F. A. Turner, assistant engineer, Texas & Pacific.

Job Tuthill, assistant chief engineer, Pere Marquette.

B. A. Wait, instrumentman, Chicago, Rock Island & Pacific.

J. H. Waterman, representative, Curtin-Howe Corporation (formerly superintendent timber preservation, Chicago, Burlington & Quincy).

*Charter Member.

Publications

The "Manual."—It was contemplated to issue a revised Manual during the past year. On request of several committees, the board of direction has postponed the issuance of this volume to afford the respective committees more time in which to reconcile certain discrepancies, eliminate duplication and otherwise to perfect the material to be contained in the

Manual. The revised Manual will be issued as promptly as practicable after the annual meeting.

Finances

The Financial Statement, appended to this report, gives in detail the receipts, and disbursements. It will be noted that the receipts exceeded the expenditures by $2,321.21.

The expenditures for printing will be unusually large during the current year. A new Manual is to be issued, also a General Index, in addition to the voluminous bulletins and proceedings. It will therefore be necessary to devise ways and means for increasing our revenues to meet these obligations.

Miscellaneous

On the recommendation of the Committee on Outline of Work, the Board of Direction approved a revision of the "General Rules" covering committee reports, and in carrying out the intent of these revisions, the Board Committees on Outline of Work and on Personnel promulgated the program for the ensuing year and the personnel of the standing and special committees on January 1. The early announcement of subjects to be studied and reported on and committee appointments will enable committee work to be carried on during the winter months and make it possible to complete the reports in time to be issued to the membership well in advance of the annual meetings.

Robert H. Ford and John V. Neubert, respectively, chairmen of the board committees on Outline of Work and Personnel of Committees, deserve credit for this distinct advance in committee-work.

"Reporters" for International Railway Congress in Spain.—The following members of the A. R. E. A. have been appointed "Reporters" for the International Railway Congress, to be held in Madrid, Spain, in 1930:

"Investigation into the static and dynamic stresses in railway bridges."—P. G. Lang, Jr., engineer bridges, Baltimore & Ohio.

"Co-operation of the staff toward increased efficiency and participation in the profits."—C. C. Cook, maintenance engineer, Baltimore & Ohio Railroad.

"Methods followed in training of staff—professional, technical and ordinary grades."—L. C. Fritch, vice-president, Chicago, Rock Island & Pacific.

World Engineering Congress.—The Kogakkai (Engineering Society of Japan) announces a World Engineering Congress, to be held in Tokio, Japan, in October, 1929.

The patron of the Congress is His Imperial Highness, Prince Yasuhito of Chichibu; honorary president, His Excellency, the prime minister of Japan; honorary vice-president, His Excellency, the minister of the department of commerce and industry, Viscount Eiichi Shibusawa.

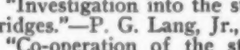
An invitation has been extended to the American Railway Engineering Association to participate in the Congress and to delegate a representative. The Board of Direction has accepted the invitation, and appointed Secretary E. H. Fritch to represent the association at the Congress.

Financial Statement for Calendar Year Ending December 31, 1928

Balance on hand January 1, 1928		$54,005.45
RECEIPTS		
Membership Account		
Entrance Fees	$ 3,310.00	
Dues	26,031.16	
Binding Proceedings and Manual	1,988.83	
Badges	27.00	
Sales of Publications		
Proceedings	4,395.88	
Bulletins	1,933.66	
Manual	368.89	
Specifications	793.26	
Leaflets	524.88	
Advertising		
Publications	2,364.60	
Interest Account		
Investments	2,111.25	
Bank Balance	218.70	
Annual Meeting		
Sale of Dinner Tickets	5,045.00	
Miscellaneous	25.35	
American Railway Association		
Rail Investigations	8,946.94	
Total		$58,085.40
DISBURSEMENTS		
Salaries	$10,162.42	
Proceedings	7,392.51	
Bulletins	16,091.57	
Manual	25.00	
Stationery and Printing	1,924.10	
Rents, Light, etc.	845.00	
Supplies	774.83	
Expressage	772.35	
Postage	1,163.85	
Exchange	166.05	
Committee Expenses	93.40	
Officers' Expenses	548.86	
Annual Meeting	6,611.54	
Refund Dues, etc.	55.00	
Audit	200.00	
Miscellaneous	665.39	
American Railway Assn.—Rail Investigations	8,272.32	
Total		$55,764.19
Excess of Receipts over Disbursements		$ 2,321.21
Balance on hand December 31, 1928		$56,326.66

Report of the Committee on Roadway

Studies of permanent roadbed and culvert pipe form largest part of this year's work



C. W. Baldridge
Chairman

THE committee presented a report covering the following subjects:

(1) Revision of Manual (Appendix A).

(2) Deformation of roadbed in the light of data developed by the Special Committee on Stresses in Railroad Track, with special reference to its effect on track maintenance (Appendix B).

(3) Improved methods for preventing corrosion of fence wire (Appendix C).

(4) Permanent roadbed construction, collaborating with Committee V—Track (Appendix D).

(5) Conditions which should govern the use of culverts in construction and maintenance, and the factors which determine the most suitable type to be used (Appendix E).

(6) Drainage areas and water runoff, and the proper sizes of waterway openings required under the differing conditions in various parts of the country (Appendix F).

(7) Prepare specifications for cast iron; for corrugated; and other types of metal culverts (Appendix G).

(8) Develop best methods of preventing the formation of water pockets under the ballast when embankments are widened and/or raised (Appendix H).

The committee recommended that the definitions offered in Appendix A be included in the Manual; that Appendices B and E be received as information and the subjects discontinued; that the subject of Appendix C be modified and reassigned; that Appendix D be received as information and reassigned; that Appendix F be received as a progress report and the subject reassigned; that Appendix G be reassigned with the idea that the committee will present final specifications next year; and that Appendix H be adopted for inclusion in the Manual and the subject discontinued.

Appendix A—Revision of the Manual

Under this assignment, the Committee gave the two following definitions:

Grade (noun).—The ratio of rise, or fall, of the grade line to its length, computed in length of construction stations.

Sug-grade (noun).—The finished surface of the roadbed before the application of ballast or track.

NOTE.—The term "Grade" is sometimes used to designate the finished roadbed, but such use conflicts with the meaning of "grade" as given above and it should not be so used.

Appendix B—Deformation of Roadbed

The committee confined its report on this subject to a review and compilation of the record of the work which has been done by the Ballast committee and the Roadway committee on the determination of the proper depth of ballast to insure even pressure distribution, and the use of concrete slabs. The conclusions of the committee were as follows:

CONCLUSIONS

In view of the work already done by the association, the committee believes that any further immediate study along the lines it has been following would be merely a repetition of work.

The committee recommends that an effort be made to collect data relative to maintenance costs for various ballast depths and track conditions, and that observations be made on recently constructed lines to determine the amount and rate of penetration of the ballast into the subgrade during the period following construction. For the present the committee recommends that the subject be discontinued.

Appendix D—Permanent Roadbed

The committee conferred with railroads it knew had some form of permanent roadbed and also made an inspection of the Pere Marquette's installation at Beech, Michigan. Also, one member of the committee inspected the roadbed in the Michigan Central's tunnel at Detroit, Michigan. The findings of the committee are abstracted in the following:

Pere Marquette Track at Beech, Mich.

A description of this installation is given in 1927 A.R.E.A. Proceedings and a report on it is in the 1928 Proceedings. The experimental section of concrete roadbed installed by the Pere Marquette in 1926, remains in essentially the same condition as a year ago. In January, 1928, the material formerly used for insulation under the rail having proven entirely unsuitable, was removed and replaced with compressed wood fibre of the type ordinarily used for insulating switches. This material was applied for the entire length of the north rail. The south rail is in direct contact with the concrete. At the same time the gage was reduced and the alinement improved by substituting rail clips which had a greater distance between the bolt hole and the shoulder that bears against the rail. The new insulation has eliminated signal trouble.

Measurements of rail batter made in July show no increase since last December. In fact, these measurements show a decrease. The rails were not canted and after 19 months operation are not yet entirely covered by wheel wear, thus indicating that the rail wear is not excessive.

No transverse cracks in the concrete developed since September, 1927, at which time a hair crack was discovered in slab No. 11 which extended the full width of the slab, in addition to the three slabs in which hair cracks had previously appeared. No cutting of the rail into the concrete has yet occurred, at least not in a measurable amount.

Since the rails were anchored on the approaches to the concrete roadbed, no creeping has been observed, except a forward and backward movement due to expansion and contraction. This movement does not exceed two inches at any point.

Little change is noticeable in the riding qualities, although there appears to be a little less of the metallic clang which characterized the earlier operation.

Additional settlement averaging about ½ in. took place between December, 1927, and July, 1928. This settlement took place during the winter and early spring, as indicated by some levels taken in April. Practically none has taken place since. This settlement, like that which preceded it, is so uniform that it does not affect the riding qualities of the track.

Michigan Central Tunnel, Detroit, Michigan

Untreated yellow pine ties were used, both in the original construction in 1910 and for renewals. Tie plates are used throughout. After 18 years' service, it is estimated that 70 per cent of the original ties are still in place. A large number of those taken out were damaged by derailments. Untreated pine ties were used instead of creosoted or oak ties, for the reason that they would absorb moisture and swell to such an extent that any motion of the tie would be prevented. This is regarded as an essential feature in the stability of the track. However, it makes the renewal of the ties a somewhat difficult and expensive matter, as they must be chopped out. Uniform conditions as to moisture have evidently had a very beneficial effect on the life of these ties.

The 100-lb. rail originally laid was replaced by 105-lb. and later by 127-lb. open-hearth rail, except on one of the two 2-deg. curves which are located near each end of the subaqueous portion of the tunnel. One of these curves is now laid with 105-lb. manganese rail on the high side and a special 93-lb. high carbon "frictionless" rail with a narrow head on the other. These curves have a super-elevation of 2 in. The open-hearth rail is renewed at intervals of four or five years, as compared, with eight or nine years outside the tunnel. This short life is not due to the track construction, as there is no more rail wear and no more batter than on ordinary track; but is due solely to corrosion of the base through electrolytic action. In order to reduce this, various kinds of paint have been tried; but so far without success. This action is somewhat less in the high carbon "frictionless" rail and still less in the manganese. The track is in good line and surface and very little labor is expended in keeping it so.

Chicago Junction Railway

There was a total of 654 ft. of track in this installation; 119 ft. under one main track, 417 ft. under second main track and 118 ft. under a passing track. Cost, not including rail, was $1,830. It was laid in 1911 and gave very little trouble until 1921 when it was necessary to renew the ties, which was very expensive. Subsequently, difficulty in holding track to good surface was encountered. Recently, a portion has been removed and replaced with standard construction, partly because of the construction of a crossover, but also due to expense of maintenance. The tracks carry slow speed traffic of 12 to 15 miles

Personnel of the Committee on Roadway

C. W. Baldridge, asst. engr., A. T. & S. F., Chicago
Chairman

Anton Anderson, engr. m. w., C. I. & L., Lafayette, Ind.
H. B. Barry, prin. asst. engr., St. L. S. F., St. Louis, Mo.
E. J. Bayer, engr. m. w., P. & E., Indianapolis, Ind.
A. E. Botts, div. engr., C. & O., Huntington, W. Va.
W. G. Brown, engr. m. w., F. E. C., St. Augustine, Fla.
Paul Chipman, val. engr., P. M., Detroit, Mich.
A. C. Clark, dist. engr., B. & O., Pittsburgh, Pa.
Hardy Cross, prof. of struct. engr., U. of Ill., Urbana, Ill.
G. S. Fanning, asst. ch. engr., Erie, New York.
J. L. Fergus, div. engr., N. C. & St. L., Chattanooga, Tenn.
J. A. Given, div. engr., S. P., Dunsmuir, Cal.
J. S. Goodman, div. engr., Reading, Reading, Pa.
F. W. Hillman, asst. engr. of maint., C. & N. W., Chicago.
Daniel Hillman, engr. of const., C. P. R., Montreal, Que., Can.
A. A. Johnson, trk. engr., D. L. & W., Hoboken, N. J.
Noah Johnson, val. engr., Wabash, St. Louis, Mo.
H. W. Legro, ind. engr., B. & M., Boston, Mass.
W. H. Woodbury, val. engr., D. & I. R., Duluth, Minn.
Vice-chairman

H. T. Livingston, div. engr., C. R. I. & P., Little Rock, Ark.
L. C. Miller, asst. ch. engr., M. & St. L., Minneapolis, Minn.
W. G. Morgan, div. engr., K. C. S., Kansas City, Mo.
W. A. Murray, engr. m. w., N. Y. C., New York.
W. M. Neptune, prin. asst. engr., M. P., St. Louis, Mo.
J. A. Noble, div. engr., A. T. & S. F., LaJunta, Colo.
E. H. Olson, asst. engr., A. T. & S. F., Chicago.
E. C. Oyler, div. engr., Penna., Chambersburg, Pa.
O. V. Parsons, asst. engr., N. & W., Roanoke, Va.
T. M. Pittman, Jr., rdmast., I. C., Water Valley, Miss.
E. M. Smith, asst. engr., B. & M., North Hampton, N. H.
W. C. Swartout, sr. asst. engr., M. P., St. Louis, Mo.
H. E. Tyrrell, engr. m. w., Sou., St. Louis, Mo.
Jamieson Vawter, asst. prof. of c. e., U. of Ill., Urbana, Ill.
Thos. Walker, rdmast., L. & N., Louisville, Ky.
J. R. Wilks, mgr., Ingot Iron Ry. Prod. Co., Middletown, Ohio.

per hour and were not considered safe for higher speed when changes were made.

Delaware, Lackawanna & Western's Bergen Hill Tunnel

The 1927 Proceedings, Vol. 28, page 864, contains a description of this installation. It was built in 1909 and replaced in 1925 with standard stone ballast construction because of failure of the concrete and resulting difficulty in holding track to line and gage. Up to time of failure of concrete, the maintenance cost on the track was low. The rail did not last any longer than in standard track and occasionally developed battered joints.

Northern Pacific

The installations on this railroad were described in the 1927 Proceedings. Inquiries brought no further information than contained therein except to corroborate Mr. Tratman's remarks and subsequent comment by Mr. Baldridge.

Union Station, Chicago

During the past year there has been settlement of some of the slabs directly supporting rails, mud being forced up through some of the joints. Holes were drilled through the slab and air forced into them, thus forcing mud out. When water began to show clear, cement grout was forced under slabs with air until it began to show up through holes and joints. This was first done late in 1927 and appeared to be successful enough to warrant trying it more extensively. It must be remembered that conditions surrounting this installation are very unusual because the bottoms of the slabs are a considerable distance below the surface of the Chicago river which is close by. However, the condition described above indicates that serious thought must be given to the stability of foundation under slabs and the possible necessity of varying the design of the slab as the bearing capacity of the underlying soil differs.

The remainder of this report consisted largely of the results of tests made by Mr. Chipman to determine the train resistance of the track on the Pere Marquette's experimental section of concrete roadbed at Beech, Mich.

Appendix E—The Conditions Which Should Govern the Use of Culverts

The selecting of a culvert is, of course, governed by topography and local conditions, and the type of structure selected depends not only upon the first cost, but renewals and maintenance. There seems to be a growing tendency to install culverts in preference to bridges wherever possible, and it has been customary for a number of years to make investigation covering drainage areas and other pertinent features in connection with bridges on some of the railroads in this country, with the idea of making replacements with culverts to reduce maintenance cost.

In determining the size of openings, the first consideration must be given to the volume of water to be taken care of. Usually the first source of information sought is the history of the opening and the high water marks. In case no historical facts are available, nor high water marks known, dependence is then placed upon drainage tables, together with other known information pertaining to the actual area drained.

Some of the factors considered in determining the type of structure are: Drainage area; prairie, woody or cultivated; rapidity of flow, slopes; height of embankment; possible back water due to excessive rain fall, with respect to damage of adjacent property; concentration of flow to one point to prevent cutting of adjacent land on down stream side, with especial consideration to the legal possibilities of damage; depth of streams at point crossed with relation to surrounding land, permanency and loads and stresses.

It is necessary to give consideration to the character of the underlying soil conditions where pipe is used, in order to avoid possibility of settlement. Pipe is quite generally used for an opening up to six feet in diameter, and beyond this size arches and concrete boxes are used, concrete boxes being preferred.

Cast iron pipe is a material of great value, practically indestructible and makes an excellent culvert, but the consideration of first cost is causing its displacement for use as railway culverts, except in special situations. Vitrified clay pipe and non-reinforced concrete pipe are not recommended for use under railway tracks.

In determining the use of pipe for culvert purposes, the co-efficient of roughness in the culvert pipe and the formula for carrying capacity of culverts of any length, the magnitude of each hydraulic element involved in the actual discharge of the culvert must necessarily be known.

It is our understanding that tests are now being conducted with reference to an expanded outlet, both on concrete boxes and also on culvert pipes of various types. This expanded outlet has the same effect on the culvert as a draft tube has on a turbine and by converting velocity head to pressure head, greater efficiency is secured. This type of outlet has additional merit in that the outlet velocities are greatly reduced and the destructive scour is avoided.

Friction, resistance to flow through various culverts, may have bearing on the selection of the type to be used. At a recent test between concrete pipe, vitrified clay pipe, and corrugated metal pipe, it showed that the velocity in the concrete pipe was 7.00 ft. per second, the vitrified clay pipe has a velocity of 6.98 ft. per second, and the corrugated metal pipe had a velocity of 5.96 ft. per second. Therefore, it is apparent the smoothness of the walls of the concrete pipe evidently was conducive to the least friction and consequently greater velocity.

In determining to what extent topographical features enter into the type of culverts used, that is: mountainous, desert, swamp, etc., there are a number of theoretical considerations which necessarily should be kept in mind in determining the conclusions, such as density of timber, intensity of rain fall, gradient of area drained, etc. However, the attention given these factors will to that extent affect the compilation of data for which the drainage table has been made.

We find that the effect of vegetation and timber is not taken into the consideration in the calculation for waterways by many roads, as they go on the theory that it will eventually be cut. In considering loads and traffic conditions over proposed openings, it is necessary to see that the intensity of pressure on the underlying soil is safe and that the structure has been properly designed to withstand the superimposed load.

Up to a depth of fill of 15 ft. over the culvert, it will be well to calculate for the full dead load, live load and full impact for a width of 13 ft. For depths of fill on the culvert over 15 ft. it will be well to calculate for full dead load and live loads without impact. In figuring the loading of a culvert, it will of course be necessary to make it as strong as the bridges in same territory. All pipes or boxes should be placed a minimum of two feet deep under the ballast. For openings in which this head room cannot be obtained, concrete boxes having sufficient foundation and top strength to carry load under ballast should be used.

One railroad is using Cooper's E-60 loading plus dead load of embankment over same, plus 50 per cent of live load for impact if located within a few feet of base of rail, and 25 per cent for impact where in excess of 8 ft. or 10 ft. below base of rail. If the fill is too low for culvert design to give sufficient cushion between the track and the structure, of course, the bridge will be necessary.

The character of soil or material used in roadway over culverts should be such that it is not easily saturated and of that consistency that it would permit water to run off readily and not conducive of slides, soft spots in track, and water pockets.

An historical record of the behavior of all streams of whatever magnitude, to which ready reference could be had by all responsible for design and maintenance, would be a valuable guide in determining the proper size of opening and the proper type to be used. After the new structure has been built the record should be continued.

It is a good practice to place all culverts on a grade and to have the last half of the length of culvert on a heavier grade than the first half. This will prevent sag in the event there is a settlement of the culvert under the tracks where the load is heaviest.

Appendix G—Specifications for Metal Culverts for Railroad Use

In presenting specifications for corrugated metal culvert pipe and cast iron culvert pipe, the committee recommended that the specifications be studied by the association so that they can be revised if necessary and presented for final adoption in March, 1930. From its study the committee recommended that the minimum gage of sheets to be used for various diameters of corrugated metal culverts under different heights of fill should be as follows:

	Height of Fill from Flow of Pipe to Base of Rail				
Dia.	Fill Under 10′	10′ to 20′	20′ to 30′	Above 30′	Not Under Track
12″	14	14	14	14	16
18″	14	14	14	14	16
24″	12	12	12	12	14
30″	12	12	12	12	14
36″	12	12	10	10	12
42″	10	10	10	10	12
48″	10	10	8	8	10
54″	8	8	8	8	10
60″	8	8	8	8	8
Over 60″	8	8	8	8	8

The two specifications presented by the committee are given in part in the following:

Specifications for Corrugated Metal Pipe

Base Metal

Corrugated metal pipe culverts shall be fabricated from corrugated galvanized sheets, the base metal of which shall be made by the open-hearth process, unless otherwise specified in the contract.

Chemical Composition

Elements	Pure Iron	Copper Bearing Pure Iron	Copper Iron	Copper Molybdenum Iron	Copper Steel	Tolerance by Check Analysis
Carbon, max.	.....	.....	.....	.....	.....	.....
Manganese, max.	.....	.....	.....	.....	.....	.....
Phosphorus, max.	.015	.015	.015	.015	.....	.....
Sulphur, max.	.040	.040	.040	.040	.050	.010
Silicon, max.	.....	.....	.....	.....	.....	.....
Copper, min.	.....	.20	.20	.40	.20	.02
Molybdenum, min.	.....	.....	.....	.05	.....	.....
Sum of first 5 elements, max.	.....	.10	.25	.25	.70	.04
Sum of first 6 elements, max.	.10	.....	.....	.....	.....	.04

Sheets

All sheets shall be prime stock, free from injurious defects such as laminations, ragged edges, etc.

Corrugations in sheets shall not exceed 2¾ in. in width and not less than ½ in. in depth. They shall be rolled to an average of not less than U. S. Standard gage per lot weight, subject to the usual tolerance legalized by Act of Congress.

Galvanizing

Sheets shall be uniformly coated with not less than two ounces of prime quality zinc spelter per square foot of sheet. The galvanizing shall be free from cracks, blisters, pinholes, uncoated spots, or imperfections of any kind, and shall be done in accordance with the specifications for galvanizing appearing on page 889 of the Manual of 1921.

Riveting

All rivets shall be placed with heads on outside of pipe in the recess of valley of corrugations. Minimum distance from center of rivet to edge of sheet shall not be less than 2½ times the diameter of rivet. Upsetting of end of rivets on inside of pipe shall give full hemispherical head accomplished in such manner as not to remove or destroy galvanizing, shall insure a tight joint and shall present a neat and workmanlike job. Rivets shall be driven without bending and must completely fill the hole. Before punching the sheets, the joints or seams shall be tightly and evenly clinched so that the seams are tight, preventing the swelling of rivets between sheets.

Longitudinal joints shall be riveted on not to exceed 2¾ in. centers, with one row of rivets in pipe 24 in. or less in diameter and two rows of rivets in pipe of larger diameters.

Circumferential joints of pipe of all diameter shall be riveted on not to exceed five inch centers.

End Reinforcement

Culverts of 12 gage and lighter shall have ends reinforced by an iron rod of not less than ⅞ in. in diameter, and of a length equal to the circumference of the pipe, folded in the outer edge of sheets forming end sections, by folding or rolling the outer edges of the sheets forming end sections or by other suitable method acceptable to railroad company and in such manner that the galvanizing will not be broken or flaked off.

Field Joints

Long lines of pipe may be furnished in sections of greatest length to permit of most economical shipment. There shall be provided suitable bands or coupling devices for joining same securely together in the field.

(a) Bands for pipe shall have lengths and lugs shown in attached table.

Pipe Diameter	Band Length, Minimum to Engage on Each Section	Number of Lugs
8" to 15" both incl.	1 full corrugation	2
18" to 42" both incl.	2 full corrugation	3
48" and larger	3 full corrugation	4

The following gages will be used in constructing bands for culvert pipe:

Pipe	Bands
8 and 10 gage	Use 12 gage
12 gage	Use 14 gage
14 gage	Use 16 gage

(b) Lugs or fastenings on bands shall consist of forged, fully galvanized wrought iron connecting lugs and draw bolts. Each half of the lug shall be riveted to the pipe with not less than two rivets ⅜ in. in diameter. The draw bolts shall be ½ in. in diameter with not less than 3½ in. threaded length.

At the option of the railroad, culverts of 54 in. diameter and greater shall be fabricated for field riveting, in which case necessary rivets, as specified under paragraph "Rivets," must be furnished with the pipe and proper appliances for enlarging and tightening sheets of end rings.

Specifications for Cast Iron Culvert Pipe

Manufacture

The pipe shall be manufactured of cast iron of good quality and of such character as to be strong, tough and of even grain, but soft enough to admit a satisfactory drilling and cutting. The metal shall be made without any admixture of cinder iron or other inferior metal and shall be remelted in a cupola or air furnace. The pipe shall be hub and spigot style of cast iron water pipe or cast iron culvert pipe, or spiral corrugated cast iron pipe, or a ribbed or corrugated cast iron pipe of design approved by railroad company, smooth, free from scales, lumps, blisters and other defects impairing its strength or durability, and be round, of uniform physical character, of close grain, and cast vertically. It shall be manufactured in lengths of not less than three feet, and the inner and outer surfaces shall be true, whole, concentric cylinders. This pipe shall be heated to 300 deg. F. and immersed in coal tar varnish so that the result will be a smooth coating on both the inside and outside of the pipe. This coating must be of such a nature that it will be tough, tenacious, not brittle or have any tendency to scale when cold; and such results shall be consistent.

Physical Properties and Tests

Cast iron pipe shall have the following minimum thicknesses for the given inside diameters: 12 in.—⅞ in.; 14 in.—⅞ in.; 16 in.—½ in.; 18 in.—½ in.; 20 in.—½ in.; 24 in.—⅝ in.; 30 in.—11/16 in.; 36 in.—13/16 in.; 42 in.—15/16 in.; and 48 in.—1¼ in.

No pipe shall be accepted the thickness of which is ⅛ in. less than the thickness herein specified.

The transverse test shall be used to determine the physical properties. The test bar shall be the 1 in. by 2 in. by 28 in., American Foundrymen's Association Standard rectangular bar.

The test shall be transverse with the bar placed horizontally upon supports 24 in. apart and a concentrated load applied midway between the supports.

The test shall conform to the following requirements as a minimum:

Average load at the center.....2200 lb.
Average deflection at center.....0.30 in.

All pipe shall be carefully examined for defects and sounded with a hammer before shipment. No fillings with metal, cement or other materials, or so-called "burning on" of iron, will be permitted. The castings shall be sound and free from cracks, sandholes, blow holes and cold shots.

Appendix H—Methods of Preventing Water Pockets Under the Ballast When Embankments Are Widened and/or Raised

When embankments are to be widened and/or raised, field studies should be made to determine the elevation of bottom of existing ballast, the filling material, if of impervious nature, to be kept below such ballast level and sloped outward. Any additional filling material needed to complete a higher roadbed section should consist of porous material.

In case porous material is not available for such higher section, longitudinal and cross drains are necessary, the type, sizes, spacing of cross-drains, etc., to be determined by studies of each location. They should be laid at such depth as to be below any movement of the subgrade. Excavation for such drains must be taken out to below frost line, and made to proper grade. Subdrains should be laid to regular line and true grade, and covered with pervious material.

Discussion

[Chairman C. W. Baldridge (A. T. & S. F.) presented the report on revisions of the Manual, which was accepted, following which Subcommittee Chairman Prof. J. Vawter (U. of Ill.) presented the report on Deformation of Roadbed, which was offered for information with the recommendation that the subject be discontinued.]

E. R. Lewis (M. C.): I urge that this subject of Deformation of Roadbed, especially the portion referring to drainage, be retained, and further information be selected by the association. There is no more important engineering subject than drainage. I don't know of any subject that is more nearly ignored, not only in railroad building and maintenance, but in all structural engineering. Good

drainage is a cure for about 90 per cent of all ills of track.

We know the importance of track drainage, but we are not getting anywhere. I have maintained for a long time that dry track doesn't cost half as much to maintain as wet track. Drainage costs money, but the money is well spent. The trouble is that engineers are afraid to launch out and do something that someone may criticize. We have done about one-tenth of the construction that we should do on maintenance and drainage. We are getting farther behind every year. In the 1921 Manual there are 1,004 pages, and only 3 references to drainage, about one full page of text.

It has been suggested that drainage has kept pace with the improvement of the railroads, that we have done as much as we could economically. I will agree that we probably did what we could when the railroads were first built. I can remember some of the old mud-ballasted railroads, and that we built ditches and put in some culverts. Sometimes they were ten times too big and sometimes they were ten times too small. We are just as unscientific now when it comes to actual railroad construction as we were then with culverts.

But the roadbed has not been drained. We built a track on it. The track started to settle and we put some ballast under it. That settled and we put in some more ballast, and we got up so far out of the bank, that we couldn't put in any more ballast. We had fine drainage but we went out of line. In a cut we secured some clay and put that on each side of the ballast. We trapped the ballast and we trapped the water there, and it is there yet. Every ballast cross-section has a concave base; every railroad is being maintained on a ballast filled trench, making more work for us all the time. I believe every dollar that is spent on the improvement of drainage under the ballast is worth $10 of labor spent on the top.

I believe every engineer who starts to make an estimate should put drainage at the top of the list. It will be found that an allowance of from 4 to 10 per cent of the cost for the drainage in a yard won't be far off.

I move that this subject be retained, and that the association take the lead in bringing drainage before the profession.

R. H. Ford (C. R. I. & P.): I don't know of any one subject that has been so thoroughly canvassed as this question of drainage. So far as the association is concerned, I think it has pretty well exhausted the subject, except for keeping it up to date, and that is within the scope of the committee's work on the Manual. I concur in the recommendations of the committee that the subject be dropped.

J. E. Willoughby (A. C. L.): I support Mr. Lewis' motion that the subject be continued. The subject was, "Continue the study of deformation of roadbed in the light of data developed by the Special Committee on Stresses in Railroad Track." The deformation of a roadbed will be ever with us. The present committee seems to consider that deformation lies solely in the roadbed. There are other things to study, the subsidence of the ground on which the roadbed rests, and the correction of that.

[*The motion to continue the study of drainage was put to a vote and carried.*]

Mr. Lewis: Dr. George E. Ladd is here. He is consulting geologist of the Federal Highway Department, and I am sure he can tell us something that we don't know on this subject.

President Faucette: Dr. Ladd, it will be a pleasure for us to hear you. (Applause.)

Dr. Ladd: I am a new member of this organization. The principal reason that inspired me to join it was that I might possibly render some service, or that I would have an opportunity to learn a great deal. I very nearly discovered that you were through with the subject, and that I wouldn't have an opportunity to learn anything. I have spent practically eleven years upon this one subject. For seven years I have pried into the drainage of desiccating areas that subside or move and cost money.

I have been traveling a little over a year and covered nearly 70,000 miles. In addition to a large amount of work in connection with highways and other subjects, I was called upon to investigate many problems of railroads. I think altogether I have done work in the last year on 18 railroads, all the way from New Mexico to the Canadian Pacific and Canadian National, and pretty largely over the United States. I had thought that highway engineers were a hard lot to deal with—ultra conservative—but the railway engineers are more so.

I believe, with Mr. Lewis, that there is a large amount of waste. The construction engineer goes ahead and builds something. It then comes back on the maintenance engineer, and the money is plowed in. I know of innumerable cases where, with proper control of what you call drainage, the interest on the investment required to stabilize a soft spot or moving ground would be small as compared with the continuous, perpetual annual expenditure that goes into maintenance and is very largely covered up.

I would suggest that you do not just look at the maintenance figures, but that you look at the costs at given places; assemble those figures and put it up to the executives. You will see that you can save annually large sums of money by drainage. The time is coming, if it has not already arrived, when the Interstate Commerce Commission with its new attitude of prudential investment is going into these subjects. (Applause.)

[The report on Preventing Corrosion of Fence Wire was presented and *accepted* and Subcommittee Chairman F. W. Hillman (C. & N. W.) then presented the report on Permanent Roadbed, *which was accepted.* Subcommittee Chairman A. E. Botts (C. & O.) then presented the report on the Use of Culverts, after which the report on Specifications for Metal Culverts was presented by Subcommittee Chairman W. C. Swartout (M. P.).]

Mr. Swartout: The specification for cast iron pipe meets a need that is self-evident. We have been specifying cast iron culvert pipe generally by simply stating that pipe shall be Class A, B or C cast iron water pipe, as may suit the ideas of the engineer writing the specification, without much study or thought being given to the conditions under which the pipe will be used or whether the conditions vary from location to location. Frequently the pipe used for culverts is rejected water-pressure pipe which is used without regard to the defect or defects which caused the rejection. It is our belief that the specifications as they now stand amply protect the railroads on the quality of the material, while on the other hand, we do not believe that any manufacturer can complain.

The proposition of three-point bearing versus field

tests is not a new one to this committee. Our opinion on this subject was stated in the first report of the committee on Corrugated Metal Culverts for Railroad Purposes. Subsequent studies by ourselves and other investigators have substantiated and strengthened this opinion.

We are not recommending the adoption of these specifications by this convention, but are offering them as information with the hope that the membership will carefully consider them during the coming year and favor the committee with any suggestions, questions or criticisms which may occur to it. After this further study they will be called up for adoption at the 1930 convention.

[Mr. Ford requested the committee to omit from the report certain reference to patented articles and the committee accepted the suggestion for consideration, whereupon *the report was accepted.* The subcommittee report on water pockets was presented, and it *was moved to accept it for inclusion in the Manual.*]

Mr. Lewis: I am wondering if the committee would not like to consider the terms, porous material and pervious material. Isn't there some preferable porous material and some preferable pervious material that may be mentioned?

Chairman Baldridge: The pervious material referred to means anything that will permit the water to drain out readily, and the kind of pervious material that may be available in the different localities is so varied that it seems to me and to the committee, useless to go farther than to term it pervious material.

[*The motion to accept the report was put to a vote and carried.* The concluding report of the committee, on methods of installation and maintenance of tile and other drains along tracks or roadbed under varying conditions, was then presented, and following *its acceptance without discussion,* the committee was excused with the thanks of the association.]

Report on Water Service and Sanitation

Committee presents extended discussions on 11 different phases of the water supply problem

C. R. Knowles
Chairman

THE committee presented reports on the following subjects. (1) Revision of the Manual. (2) Pitting and corrosion of boiler tubes and sheets. (Appendix B). (3) Value of water treatment and comparison of methods. (Appendix C1 and C2). (4) Protective coatings for interior of steel water tanks and underground pipe lines. (Appendix D). (5) Incrustation in pipe lines. (Appendix E). (6) Use of gravity and pressure filters. (Appendix F). (7) Fire protection and prevention at water stations. (Appendix G). (8) Design and Maintenance of track pans for locomotive supply. (Appendix H). (9) Methods used in obtaining wells in fine sand formation. (Appendix I). (10) Water columns and their advantages in delivering water for locomotives. (Appendix J). (11) Federal and state regulations pertaining to drinking water supplies. (Appendix K). (12) Methods and practices of handling water for drinking purposes by the railroads. (Appendix L). (13) Coach yard sanitation. (Appendix M). (14) A Monograph. The association's opportunity for promoting railway sanitation. (Appendix N).

The committee recommended that subjects 1, 11 and 13, Appendices A, K and M, be referred back to it for further study and report; that subjects 2, 3, 8 and 12, Appendices B, C1, C2, H and L be received as information and reassigned for further study and report; and that subjects 4, 5, 6, 7, 9 and 10, Appendices D, E, F, G, I and J, be received as information and accepted as final reports.

Appendix B—The Causes and Extent of Pitting and Corrosion of Locomotive Boiler Tubes and Sheets

The report of the committee under this subject is given in part as follows:

In the study of corrosion we must consider two things—the metal which is being corroded and wasted away, and water, the medium through which the wasting is taking place. It is quite true that without moisture or water corrosion does not occur, but it is equally true that the same water does not corrode the various types of steel or metal to the same degree.

The first step then to be taken is to give consideration to the proper kind of steel or metal to be used. The best water obtainable may be very corrosive to certain kinds of steel.

Flues and sheets are quite generally purchased according to specifications which cover the kind and amount of impurities or constituents and certain physical tests. The physical tests incorporated in most of the specifications are intended to correct faults in manufacture, chemical tests of faulty material having shown that certain elements may be present in proper amounts, yet for some reason the metal is not giving the service it should.

The fact that a number of roads are making tests of flues of Toncan steel, an alloy steel carrying copper and molybdenum, and of leadized flues, neither of which is covered by specification, indicates that a better material than that secured by buying according to specification is being sought.

The roads making tests on flues of special steel containing certain alloys, and those with protective coverings, report more or less favorable results. These tests, however, have not yet been extensive enough or of sufficient duration to give positive information.

Pitting and corrosion are common to all roads heard from but there seems to be quite a difference in the amount and the location in the boiler where the attack is greatest. It appears to be the common experience of all that the knuckle of the flue sheets and the areas around staybolts and radial stays are the points of greatest attack. These are points of greatest strain also.

A careful study of the types of water reported as being noticeably corrosive by the various roads replying to our questionnaire develops the fact that two types of water are quite corrosive. One type is quite common to most roads; the other uncommon and may require special consideration to overcome its tendency to pit or corrode. The type most commonly met with includes those waters high in magnesium salts, especially the sulphate and more rarely the chloride.

Most of those reporting trouble from waters of this type are treating them with beneficial results, yet complete elimination of corrosion is difficult to secure because of the slow precipitation of the magnesium.

The second type of waters which has been found to be

corrosive is low in solids and has a high hydrogen ion concentration. Corrosion due to action of this kind can be eliminated by treatment with soda ash or by lime and soda ash proportioned to give an excess caustic soda of several grains per gallon, or by the use of a boiler compound of the proper type.

Because there appears to be a great difference in the way corrosion attacks the flues and sheets of engines operating under the same conditions on the same districts using the same waters in very nearly equal amounts, it is felt that corrosion is in part at least an electrolytic phenomenon due to a variety of causes, such as impurities in and segregation of the various constituents of the steel or iron, different kinds of steel or iron used in the same boiler, or of safe-ending flues with metal of a different type from the flue itself, strains in the metal, difference in concentration of solids and sludge in the boiler water, and of difference of temperature in the various parts of the boiler; also stray electrical currents from electrical equipment on trains and power plants adjacent to railroad facilities.

While it is considered quite certain that the included gases in water, especially oxygen, have a very vital effect upon the corrosion in locomotive boilers the data available to prove this is very limited. The rapid corrosion of the tubes in the preheaters of the mallets on roads operating this type of power and the comparative freedom from pitting of the tubes in the main part of the boiler seems to be a very strong argument in favor of this agency being a very important one.

Many of the boiler compounds now being used are mixtures of material, inhibitive material with alkaline substances and organic emulsifying agents for oil, etc., so that no reliable data is available regarding the effects of any one material on corrosion. While many roads are using the hot water boiler washing system and feel that beneficial results are being had, no reliable data is available at this time.

It has been noted by some of the roads who store engines that considerable corrosion takes place while the locomotives are out of service. Some advocate thoroughly drying and sealing up the boilers; others to blow out while hot and remove all plugs to allow free circulation of air.

The conclusions arrived at by the committee were as follows:

Conclusions

(1) Secure a metal highly resistant to corrosion.

(2) Eliminate by specifications and inspection during process of manufacture defects in manufacture.

(3) Careful consideration should be given to the design of locomotive boilers to eliminate as far as possible the undue strains.

(4) Such equipment as feedwater heaters, so designed that the amount of included gases in the feedwater is reduced, should be utilized.

(5) The most corrosive type of water is one high in magnesium sulphate or chloride and should be entirely eliminated as a supply or so treated as to remove the magnesium before the water enters the boiler, and sufficient excess causticity maintained to neutralize any dissociation of unremoved magnesium salt.

(6) Waters corrosive account of having a high hydrogen ion concentration should be so treated as to reduce it.

(7) An excess of caustic alkali should be used to minimize the effect of included oxygen or corrosion.

(8) Some method should be devised to give increased protection against corrosion inside of locomotive boilers while they are in storage.

Appendix C1—Cost of Impurities in Locomotive Water

(a) Methods of Water Treatment Where Complete Lime and Soda-Ash Treating Plants Cannot Be Justified, or Pending Their Construction

In softening water for boilers it is desirable not alone that the calcium and magnesium be extracted, and the water therefore made soft, but that the carbonic acid and the sulphate radicle (combined with the calcium and magnesium) be removed and all precipitate separated from the water. At some early date we expect to have a satsfactory method and equipment for accomplishing all of this, and that will be the "complete" method, but meantime the lime-soda method accomplishes all but the removal of the sulphate radicle and therefore this method is called "complete" though it is not quite true.

The zeolite method makes water acceptably soft and leaves no precipitate but it fails to remove the carbonic acid and the sulphate radicle, both of which are left in the water combined with soda. The soda-ash method precipitates the calcium and magnesium but fails to remove from the water either the precipitate, the carbonic acid or the sulphate radicle.

The best of the anti-scale compounds, whether fed to the water in the roadside tank or to the water in the boiler, merely precipitate in the water enough calcium or magnesium salt to insure a part, or sometimes all, of the remaining calcium and magnesium salts being brought down as sludge and not as hard scale on the flues or sheets but these compounds contain (in addition to soda-ash) also organic matter which aids the precipitation and in some waters tends to prevent foaming.

None of these latter methods is as nearly "complete" for boiler purposes as is the lime-soda method, nor are they always cheaper in chemicals, but the construction costs are less and they are the methods in common use where, either because of low hardness or of small consumption, lime-soda plants are not considered justified, or pending their construction. Of these latter methods, circumstances may warrant the use of any one in particular cases. Only clean soft water should go into a boiler, that all these methods for depositing sludge in a boiler are merely ameliorants and that the expression "complete treating plants are not justified" should be used with caution. The value to a railroad of water exactly suited to boiler use, that is, clean soft water free from carbonic acid and low in sodium sulphate and chloride, is so great that no imaginable price is prohibitive.

It is astonishing what damage is done to a boiler by water only a few grains-per-gallon hard, especially if there is a fraction of a grain of calcium or magnesium sulphate, and we reiterate our statement of 1927 (Proceedings, page 227) that

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Chairman

R. C. Bardwell, supt. water supply, C. & O., Richmond, Va.
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Steel, D. A., assoc. editor, Railway Age, Chicago.
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"few natural waters are so good that some form of treatment does not improve them."

A valuable and timely paper on this subject, "The Treatment of Boiler Feedwaters of Low Incrustant Content," was presented at the April, 1928, meeting of the American Chemical Society by S. C. Johnson, chief chemist of the Water Supply department of the Chesapeake and Ohio. Mr. Johnson cites case after case to show that waters of low hardness do a great deal of harm to boilers unless they are treated with enough soda-ash, or its equivalent, to rid the water of all sulphate hardness and to make it sufficiently alkaline to precipitate the carbonic hardness as sludge.

There is no question of the efficiency of soda-ash with waters of low hardness if the boilers are kept well blown-down, but there is much question as to the amount of hardness which can be thus taken out within the boiler without causing foaming in ordinary road work. On the Wabash, where soda-ash alone is used for water softening in the boilers, the waters of the railroad average about 15 grains-per-gallon of incrusting solids and it is said that blowing out of boilers prevents any undue foaming. Also both the Chicago & Alton and the St. Louis-San Francisco, with much harder waters, report satisfactory operation with the same methods. Other roads have not all been able to deposit such quantities of sludge in locomotive boilers without foaming, which may be due to ineffective blow-down equipment, or to the inexperience of the men, or to the character of the water.

Where Is the Dividing Line?

Thanks to the dissemination of knowledge by a rapidly increasing corps of engineers of water service, the question is seldom asked "how hard must a water be to require softening?" but "are there any waters on this railroad which do not require softening?"

For many years the only savings of water treatment estimated in dollars and cents were those from coal, boiler repairs and washing. The committee of the American Railway Master Mechanics' Association of 1870 reported that the damage done to the average locomotive by hard and muddy waters amounted to $750 per year in additional coal, boiler repairs and washing. This sum today amounts to about $4,000 per locomotive per year. But this enormous loss is due to additional fuel and boiler maintenance only, and there is nothing included for the loss of engine time while undergoing these extra repairs and washings, nothing for the injury to train service from boiler failures on the road, nothing for train delays while waiting for engines from the roundhouse, nothing for the loss of spirit in the men from lack of dependability in the boiler.

On the parts of a railroad where damage in additional fuel and boiler repairs amounts to $4,000 per locomotive per year, it is stated that the average time out of service undergoing backshop repairs is two months per year, or one-sixth of the engine's time, and if we adopt the usual figures of $20 to $40 per day as the value to the railroad of an engine's time, we have $1,200 to $2,400 per year per locomotive as the commencement of our additional savings from the use of good boiler water.

In the other matters enumerated we can approximate definite figures by comparing the monthly reports of cost of operating a division before and after the installation of water-treating plants, and in any such case it should be understood that the resulting economies depend largely on the ability of the division superintendent to utilize the improved condition. In one case on record it is stated that on a light traffic division of 600 miles, after treating plants had been installed on 130 miles of very bad water near the middle of the division, the division operating cost dropped $25,000 per month solely because of the dependability of the locomotives. For one year this amounts to $300,000, or $500 per mile per year, or $6,000 per year for each of the 50 locomotives employed. The value of water-treating will also be apparent to anyone who considers the economies introduced by the long locomotive runs of today and knows that few of them would have been possible with the untreated locomotive waters of even 15 years ago.

This proof of the importance of using in locomotives only the best of boiler water does not enable us to determine the point at which complete treatments with lime and soda, and either alum, ferrous sulphate or sodium aluminate should end, and only interior boiler treatment commence, but it shows the desirable qualities of boiler water and that for any particular water under consideration, it is economical to install a plant for complete treatment unless interior treatment can effect these results without serious detriment to even one train per day. For most clean waters the dividing lines are at about 10 grains-per-gallon carbonate hardness, and 5,000 gallons per day consumption.

Appendix C2—Cost of Impurities in Locomotive Water

(b) Progress in Water Treatment and Future Development

Following a review of the progress of water treatment from the beginning of the modern art of water softening in Scotland in 1840, the committee had the following to say with reference to the future:

As to the future, we have high hopes. A few years ago scale and leaking were rampant in what we call the "bad water country" and were not unknown in other parts. Today such things are found only because the building of water softening plants has not yet covered the country. Of foaming and priming in boilers we have something yet to learn but our knowledge is being rapidly increased by intensive study.

In the matter of pitting and general corrosion under water we have made definite progress. There are now in use on three railroads of the United States three different methods of preventing, or at least greatly reducing, boiler corrosion. These three-year demonstrations have been made on only a few locomotives, but they are successful and we expect to see the day, not far ahead, when locomotive boiler pitting will be a thing of the past.

Appendix D—Protective Coatings for the Interior of Steel Tanks and Underground Pipe Lines

In discussing this subject, the committee divided tanks into three groups according to their use; water storage tanks from which water is drawn for locomotives and general use; settling tanks for water softening plants, and use as combined settling and storage tanks; tanks used in connection with hot water boiler washing plants.

Following a discussion of the materials most commonly used for protective coatings on the interior of these tanks, and more particularly, the use of Portland cement grout for this purpose on a western road, the committee offered the following in conclusion:

Conclusions

(1) For the interior of storage and treating tanks, plants using linseed oil as a vehicle require too long a drying period and do not afford protection long enough to be satisfactory. They are unsuitable for hot water boiler washing tanks.

(2) Asphaltic and coal tar liquid paints of proper composition have proven more satisfactory in storage and treating tanks but many have failed in hot water boiler washing tanks.

(3) Mastic materials composed chiefly of asphalt and coal tar pitch when applied hot in layers of 1/16 in. to 1/8 in. in thickness over a proper primer have proven very satisfactory in cold water but will not stand up in boiling water.

(4) Preparations of a petroleum base resmbling vaseline into which rust inhibiting chemicals have been compounded, have been used with good success in storage, treating and boiler washing tanks.

(5) Portland cement grout has proven very successful as a protective coating for the interior of storage, treating and boiler washing tanks.

Coatings for Underground Pipe Lines

After outlining the causes of corrosion of underground pipe lines and giving a general description of the protective coatings commonly used, the committee gave the following summary of its report on this subject:

A rough estimate of the increased life in years that may be expected by the use of the coatings described above, and a comparison of the unit cost of each, taking paint as the basis, is given below:

Coating Used	Increased Life in Years	Unit Cost
Paint coatings	2	1
Bituminous coatings	4	4
Bituminous coatings, reinforced, wrapped	5-7	6-9
Petroleum jelly base compound, wrapped	5	5
Metallic coatings	4	15
Portland cement coatings	20	30

The application of protective coatings to underground pipe lines is a question of economics and if choosing a coating for any particular location, the various factors such as permanency of the line, importance of uninterrupted service, accessibility,

character of soil and cost of protection should be carefully considered.

Appendix E—Incrustation in Pipe Lines and Methods of Prevention

After a brief statement with relation to the different factors which have an effect on the amount of incrustation in pipe lines, in which several examples were cited to show the varying effects on the rate of incrustation caused by raw and softened water, and also by the volume, pressure and temperature of the water pumped, the committee offered the following conclusions:

Conclusions

(1) Incrustation in pipe lines conveying softened water is a function of residual hardness in the water. Softening of the water which will make a reduction to one grain or less either by excess lime-soda treatment, zeolite treatment, or other methods will therefore reduce incrustation to the minimum if not entirely prevent it.

(2) Fixing of the water by use of carbon dioxide gas will prevent after-precipitation, but as a rule will not be justified in railroad practice, and if not given very close chemical supervision may produce unfavorable results.

(3) Water softening plants should be located as close as practicable to the point of consumption and thereby decrease the possibility of pipe line trouble. In large yards where raw water is available at several places, individual softening plants at two or more points may be the best solution to avoid long pipe lines subject to incrustation.

(4) The cleaning of large pipe lines incrustated from conveying softened water is usually best accomplished by the mechanical method of passing some type of cleaner through the line aided by the pressure of water from the pump and will vary in cost from 15 to 50 cents per foot depending largely on local conditions. The cleaning of smaller mains, eight inches and under, particularly where there are no long straight runs, has been handled to advantage by pumping through the line, until the precipitate is entirely dissolved, a solution of hydrochloric acid to which an inhibitor has been added to prevent corrosion of the pump or piping. The Chestnut, Oak, and also Spruce Extract have been used as inhibitors and there are several patented products on the market suitable for the same purpose. Some of the inhibitors have poisonous qualities, and if the pipe conveys water used for drinking purposes, care should be taken to be certain that the cleaned line is thoroughly flushed out before it is placed in service.

Appendix F—The Use of Gravity and Pressure Filters

In a rather extended report the committee discussed the subject of filters under the following heads: Historical, railway filtration, examples of filters operated by railways, the adaptability of filters to railway service, settling and coagulation, sand beds, drains, washing, costs, gravity vs. pressure filters, rapid vs. slow filters, and sand vs. excelsior filters.

Under the subject of railway filtration, the committee said in part as follows:

By questionnaire, the committee has obtained considerable data on the use of filters in railway service. A total of 15 railroads, reported 5,469 water stations furnishing 122,400,000,000 gal. of water annually. A total of 861 of these stations are equipped with water softening facilities, comprising 467 lime-soda plants, 241 soda-ash plants, 31 zeolite plants and 127 other types, treating 30,597,000,000 gal. of water per year or 25 per cent of the total pumped. The filters operated by these roads are limited to 134 installations of which 66 are excelsior filters, 6 are sand filters for drinking water, 53 are sand filters for water softeners, and 9 are sand filtration plants for untreated water. Of the 68 sand filters, 33 are gravity type units and 35 pressure types. Various types of tanks and construction material are represented.

The following was given in the report under the head, adaptability to railway service:

The primary object of filtration is to remove suspended matter from water. The committee finds that properly designed and operated sand filters will accomplish this purpose. They will also reduce bacteria and under some conditions, will slightly reduce the hardness of treated water. By removing mud and other suspended material which might otherwise enter the boilers and by reducing after-precipitation in pipe lines, boiler feed pipes, etc., such facilities can often prove economical. While not recommended as a substitute for sedimentation they can sometimes be utilized to reduce the cost of such facilities and should be seriously considered in all cases of turbidity in untreated boiler water and where water treating facilities fail to produce a completely settled effluent at all times.

The committee does not wish to be misunderstood. It does not recommend the indiscriminate installation of filters to correct water troubles. Where the removal of disease organisms is not involved, the installation of filters is frequently not justified and in connection with sanitation, filters are not a security against disease caused by micro-organisms without disinfection and laboratory control.

In connection with water supplies for boiler use and particularly in connection with water softening processes, filters may frequently be an unnecessary expense and even a detriment, depending upon the conditions they are made to meet, the designs employed and the attention given to their operation. A poorly or incompletely designed filter is a waste; efficient filters cannot be expected to correct wholly inefficient water softening and indifferent operation and maintenance is the signal for their eventual abandonment. This is particularly true with softening facilities where filtration is usually complicated by the tenacity with which chemical precipitates adhere to the sand grains.

The committee, however, is impressed with the increasing importance of providing clear water for locomotive boilers at all times, and seriously questions the economy of allowing sediment or precipitates to settle in distributing systems and storage or service tanks. Aware of the frequency with which it becomes impracticable at seasons to eliminate turbidity of some natural waters within a reasonable time by sedimentation alone and of the difficulty at stages of producing, without filtration, softened water that will not settle in distributing systems, it believes filtration will frequently pay large returns on the investment and maintenance. Where clarification in softening plants is uncertain filters are a safety measure.

The following conclusions were offered by the Committee:

Conclusions

(1) It is increasingly important to supply clear water to boilers.

(2) Properly designed and operated filters will produce clear water and reduce "after precipitation" in treated water.

(3) They do not dispense with sedimentation and coagulation and are recommended only where reasonable sedimentation and carefully designed softeners fail to secure the proper degree of clarification.

(4) Sand filtration is more effective than excelsior filtration.

(5) Gravity type filters are usually preferred to pressure installations for large duty stations.

(6) Rapid type filters are usually preferred to slow type filters for railway supplies.

Appendix G—Fire Protection and Prevention at Water Stations

After pointing out that the total loss to the railways of the country for the last five years through water station fires has amounted to about $400,000 and stating the causes of about 90 per cent of the water station fires, the committee made the following recommendations:

Recommendations

(a) Correction of structural defects involving fire hazard in present installations as early as practicable.

(b) In all new installations provision for ample space between wood walls or partitions and any source of heat such as furnaces, boilers, etc. For stacks on boilers, particularly when not insulated, metal thimbles should be used. The ventilating space should be not less than twice the area of the stack section.

(c) Use of fire-resistive roof materials on all wood structures.

(d) Careful construction of fuel piping with frequent inspection.

(e) Electric wiring to be installed in metal conduit and subject to thorough inspection before put in use.

(f) Thorough inspection relating to and enforcement of the proper care of premises and equipment.

(g) Provision of fire extinguishing apparatus most suitable for the building and contents. Any or all of the following may

be provided: (1) Sprinkler systems automatically controlled. (2) Fire hydrants and hose from a tank or fire pump supply. (3) Chemical fire extinguishers. (4) Fire buckets and barrels available from the outside of the buildings to be protected. (5) Sand buckets and loose sand available where fires due to oil or electricity might occur.

(h) Metal containers for oil and waste and, where warranted, metal lockers for clothing.

(i) Erection of fire resistive and slow burning structures at important points of supply or where they can be economically justified, and the erection of wood buildings only in locations where a fire would result in a small loss.

(j) Investigation of, and formal report on, all fires occurring, with report of the investigation to be given to all employees of the company having jurisdiction over installations similar to that in which the fire occurred.

Appendix H—Design and Maintenance of Trackpans

This report was presented in the form of a monograph by W. B. McCaleb, engineer water service, Pennsylvania, and ably reflected the experiences of the Pennsylvania with water pans during recent years. In dealing with this subject, the material was presented under the headings of location, design of pans, water storage, drainage, heating of water during the winter season, ice removal, cost, typical layout, maintenance and operation.

Appendix I—Obtaining Successful Wells in Fine Sand Formation

Following a statement of the trouble usually experienced in securing an adequate water supply in fine sand, the committee described four methods which have been used with varying degrees of success, depending upon the character of the sand formation, the depth of the water-bearing strata, and the quantity of water required.

Appendix J—Water Columns, Advantages Over Tank Delivery, Range of Operation, Type of Pit, and Merits of Rigid and Telescopic Spouts

After discussing all of the subjects included in this assignment, and supplementing its report with tables showing the discharge of various sizes of water columns, with different size supply lines, and under varying heads, the committee offered the following in conclusion:

Conclusions

(1) The water column is generally preferable to the tank spout on heavy traffic divisions or where more than one track is to be served. The tank spout is generally satisfactory for branch lines or light single track divisions.

(2) Water columns are adaptable to a wide range of track layouts including single, double and multiple systems.

(3) Reinforced concrete is best material for permanent water column pits. Pits should have good drainage and some form of frost proofing in hard freezing climates. Columns should be bolted directly to the pit by anchor bolts, flimsy blocking being avoided.

(4) Telescopic spouts are easier to handle, waste less water and are generally preferable to rigid spouts.

(5) Water columns should combine good hydraulic principles for large flow capacity with good mechanical principles for economy in installation and maintenance.

(6) Water column mains should be of sufficient size to supply the maximum flow required through the column after deductions for friction losses in supply main and fittings between the column and the storage tank.

Appendix M—Methods of Providing Drinking Water at Coach Yards

The assignment of the committee under Appendix M covered much the same ground as last year's report. However, this year's report presented a number of additional suggestions for the improvement of handling drinking water for passenger equipment, which the committee feels will diminish the likelihood of contamination of the water. These suggestions dealt mainly with hose, nozzles, hydrants, connections and personal hygiene. The committee made the two following statements in conclusion:

Conclusions

(1) Present methods of supplying drinking water to passenger coaches can be improved by more adequate supervision and instruction of forces watering coaches.

(2) The methods and conditions of supplying water to passenger equipment should receive more interest and study so that a solution of the problem of avoiding all chances of contamination to drinking water supplied to passenger coaches might be found.

Appendix N—Association's Opportunity for Promoting Railway Sanitation

This appendix was presented in the form of a monograph prepared by H. W. Van Hovenberg (St. L. S. W.). Some of the more important points of this paper are as follows:

The time is ripe for a better co-ordination of government sanitary requirements, based on practical railway operating conditions, and for a standardization of sanitary engineering practices by the railways as affecting operating and mechanical expenditures. We must expect that applied sanitation will cost something, but we should be convinced that our railways will be better off if these expenditures are practical and effective.

Many of our largest employers of labor have been reaping the benefits of applied sanitation for years, even among some corporations that offer only a small part of the opportunity for gain that may be found on railways. The field on railways covered by the words "railway sanitation" is too comprehensive to lead one to hope that any one railway will ever have the personnel competent to handle all phases of railway sanitation.

If we give a reasonable broad definition to railway sanitation, we may include such general or specialized work as, heating and ventilating; water supply engineering for all purposes; plumbing; sewage disposal; refuse disposal; disinfection of buildings, cars and cattle pens; standardization of disinfectants and cleaning supplies; insect and rodent control; sanitary regulations of dining cars, boarding cars, hotels and restaurants; sanitary maintenance of railway properties, including passenger cars, offices, station and railway structures; weed, grass and dust control; guidance to engineering parties with respect to protection of health by control of water, food and insects; sanitation of recreation camps, et cetera. Few of these items are covered by Federal or state regulations. The A.R.E.A. Manual is sorely deficient in information regarding any practices of the above items, as is evidenced in the case of sanitary advice in building construction to "avoid dark corners."

Discussion

[Chairman C. R. Knowles (I. C.) presented the report and introduced Subcommittee Chairman O. T. Rees (A. T. & S. F.), who submitted the matter in Appendix B.]

Mr. Rees: Our investigations have developed that specifications on the metals used in boiler construction are mostly of recent adoption and numerous tests of various kinds are still in progress to determine whether or not metals of higher resistance to corrosion cannot be found for boiler construction.

In the past, numerous cases of serious corrosion on tubes and sheets have been found due to defects in the metal caused by faulty processes in the manufacture or in the fabrication of the metal in boiler construction, causing undue stresses to develop at certain points. Manufacturers must improve their processes to eliminate these defects and users must eliminate the defective material by more rigid specifications and inspections. Careful consideration should also be given to the design of locomotive boilers to eliminate all undue strains as far as possible.

Waters carrying high concentration of magnesium salts should be eliminated if possible, and where this is impossible the water should be so treated to remove

the magnesium. Gases held in solution by a boiler feedwater have an effect upon the amount and rate of corrosion, but this can be largely eliminated by the use of proper equipment for their removal.

No reliable data appear to be available regarding the effect on corrosion of any of the materials used in the numerous boiler compounds now on the market. It has been noted by some of the roads who store engines that considerable corrosion takes place during these periods, but all are not agreed as to the best method for preventing it.

[*It was moved and carried that this report be accepted.*]

Chairman Knowles: The next report of the committee covers the discussion of methods of treatment of boiler waters of low hardness.

C. H. Koyl (C. M. St. P. & P.): This committee has been requested several times to determine the lowest degree of hardness in a water which will justify complete treatment with lime and soda ash, and we have been unable to answer it, because it is evident that the point is getting lower every year. This comes of the increasing realization that the cost of coal and boiler repairs is only part of the cost affected by unreliability of boiler operation, and when all the costs are added it is seen that the best of water is none too good and that there are few natural waters which are not improved by some form of treatment.

For those who wish a simple method for calculating from their water analyses the probable losses in the form of waste of coal and boiler repairs due to the use of any particular water, it will suffice to repeat the statement that 1,000 gal. of water containing 7 grains-per-gal. hardness, will cause a loss of 14 cents if not softened, or that each grain-per-gallon hardness costs 2 cents per 1,000 gal. removed.

If any large proportion of the hardness should be sulphate hardness, the cost is always considerably more than 2 cents per 1,000 gal.

[*It was moved that the report be received as information and the subject be reassigned to the committee for further study.*]

J. L. Campbell (N. W. P.): Mr. Koyl stated that whatever the cost of cleaning the water was, it was justified. About 20 years ago one engine district of the El Paso & Southwestern in New Mexico, used water from deep wells varying in depth from 200 ft. to 1,000 ft. The water was very bad, even after treating it to such a degree that it would no longer stay in the boiler. We eliminated that bad water by bringing water from the mountains in a pipe line which was 140 miles long, at a cost of $1,000,000 in order to reduce operating expenses.

[*The motion to accept the report was put to a vote and carried.*]

Chairman Knowles: The next subcommittee report is on Protective Coatings for the Interior of Steel Tanks and Underground Pipe Lines.

J. H. Davidson (M.-K.-T.): Protecting the interior of steel water tanks from corrosion is faced with many difficulties. This is also true of the protection of underground pipe lines. The information which this subcommittee obtained from roads all over the country indicates that very few roads have what they consider satisfactory methods of handling this problem. What we present here is just an outline to give the members an idea of some of the lines along which it might be possible to make improvements in taking care of this class of work.

[*A motion that the report be received as information was carried.*]

Chairman Knowles: The next report deals with the Incrustation in Pipe Lines and Methods of Prevention, particularly where Treated Water is Used.

[E. M. Grime (N. P.), presented the report and *it was accepted without discussion.*]

Chairman Knowles: The next report covers the Use of Gravity and Pressure Filters. This report, in the opinion of the committee, is very complete and very comprehensive on the use of filters in railway water service.

D. A. Steel (*Railway Age*): When the committee was assigned this subject it was understood to be a controversial subject within the committee itself. Some men on roads operating filters consider them useless; other members of the committee go so far as to favor filtration, not only for filtration purposes, but because of their conviction that filters have a softening action.

In addition to the controversy in the committee itself, it was recognized that some difference of opinion existed among the members of the association. So the committee faced the problem of producing information that would be acceptable, and which at the same time would reconcile striking differences of opinion that could be expected to exist in the association.

For that reason, the committee interpreted its assignment broadly, extending its studies not alone to the use of gravity and pressure filters, but covering the subject in a way to afford the railway engineer a picture of the whole field of filtration.

A distinctive feature of the report this year is the tabulation of information secured from roads having filters, showing the kind and type actually installed, their number and cost, and reporting the results obtained. Supplementary to that information and by way of amplifying it, the committee is presenting what it considers to be the first compilation of vital water statistics. By referring to the table, the association will find several roads listed, showing exactly the number of water stations, the annual pumpage of untreated and treated water, the number of wayside softening plants and number of filters in use.

The main idea that the engineer should keep in mind, in connection with filtration, is that a filter is no cure-all and that effective filtration must be preceded by sedimentation and coagulation. Without this, filtration is apt to prove a disappointment.

It is the committee's opinion that regardless of the disappointments with some filters, on the whole, in view of the growing importance of good, clean water for locomotive boilers, the question of filtration deserves careful consideration as a refining process. It assures, that under correct design, operation and supervision, water will be free from all of the foreign materials which not only clog the pipe lines and cause maintenance trouble for the engineer, but cause disturbances in boiler operation.

[*It was moved and carried that the report be accepted.*]

Chairman Knowles: The report on Fire Protection and Prevention at Water Stations includes a discussion of some of the causes of fires, and recommendations as to their prevention.

A. E. Willahan (K. C. S.): The first thing the members of this subcommittee did was to find out how much property was involved. From statistics gathered from about 75 roads we found that $44,000,000 worth of property out of a total of $220,000,000 in property was liable to damage by fire.

[*It was moved that the report be accepted.*]

R. H. Ford (C. R. I. & P.): I should like to ask if the committee complied with its instructions to confer with the Fire Protection Association.

Chairman Knowles: The committe understood that that assignment had reference to the preparation of rules for fire prevention, and would be handled with the Committee on Rules and Organization and with the Fire Protection Association.

C. W. Baldridge (A. T. & S. F.): In looking over the list of rules for fire prevention given by the commitee, I was reminded of a newspaper article I noticed during the past season. In the Middle West a river overflowed to such an extent that it flooded the pumping station. The pumping station took fire, and the pumper, who was marooned, lost his life. The fire was supposed to have resulted from the flooding of unslaked lime. It seems that the committee should recommend that a lime supply should not be stored in wooden buildings or adjacent to wooden buildings where it could cause fire.

Chairman Knowles: There are only one or two roads, if I am correctly informed, that today use unslaked lime, and they fully realize the necessity for protecting that lime in storage against moisture. As a matter of fact, some roads, including Mr. Baldridge's road, have a special arrangement for the handling of lime. It is elevated well above the ground in storage, so there is no possibility of its becoming wet.

[*A motion to accept the report was put and carried.* The subcommittee reports on Track Pans, and Obtaining Wells were then presented and accepted without discussion, whereupon Subcommittee Chairman J. P. Hanley (I. C.) presented the report on Water Columns, *and it was moved that the report be accepted.* After some comments on certain details of the report *the motion was put and carried.* This was followed by the presentation of the report on Water at Coach Yards. This was presented by Subcommittee Chairman C. M. Bardwell (M.-K.-T.).]

Mr. Bardwell: The railroads of the United States have been required to go to considerable trouble and expense to supply drinking water of certified quality to their patrons on passenger cars. In this regard it should be the desire of the railroads not only to comply with the regulations but also to protect the health of their patrons as much as possible. Some of the effort to supply safe drinking to passenger cars is of little avail on account of the possibility of contaminating the water in transporting it from the storage tank to the passenger coach. The committee has endeavored to outline methods of handling water which will minimize this chance of contamination in supplying passenger cars.

[*A motion to accept the report was put to a vote and carried.* Subcommittee Chairman W. B. McCaleb (Penna.) then gave a progress report on the methods of supplying drinking water, following which a monograph on opportunities for sanitary work, by H. O. Van Hovenberg (St. L. S. W.) was presented without discussion.]

President Faucette: Before excusing this committee I wish to say that out of the 39 members on this committee, 30 are present today. This is one of the few if not the only committee that has corresponding members in other countries. It has 15 corresponding members representing 15 different countries.

[The committee was then excused with the thanks and applause of the association.]

Report of the Committee on Ballast

Major attention is given this year to relative merits of materials, pumping joints and shrinkage

E. I. Rogers
Chairman

THE committee presented reports on the following subjects:

(1) Revision of the Manual (Appendix A).

(2) Review and report revision, if necessary, in specifications for washed gravel ballast (Appendix B).

(3) Continue the study of comparative merits of ballast material, collaborating and Committee I—Roadway, and Committee V—Track (Appendix C).

(4) Make critical study of the cause and effect of pumping joints in railway track and the excess cost of maintenance of resulting therefrom, with suitable recommendations for removal of cause, collaborating with Committee I—Roadway, and Committee V—Track (Appendix D).

(5) Continue the study of shrinkage of ballast, collaborating with Committee V—Track (Appendix E).

The committee recommended that the changes in the Manual as set forth in Appendix A, and that the changes in the specifications for washed gravel ballast set forth in Appendix B be approved; that Appendices C and D be received as information; and that Appendix E be received as an informatory progress report.

Appendix A—Revision of Manual

The committee reported that it had checked over proof sheets of all matter to be contained in the ballast section of the 1929 edition of the Manual. It recommended a change in the definition of a "foul ballast" to include the words, "disintegration of the ballast itself." The revised definition is as follows:

Foul Ballast.—Ballast which has its porosity through the filling up of the voids by cinders, coal dust, disintegration of the ballast itself, dirt or other foreign matter.

It also recommended that the words, "to provide against upheaval by frost," in paragraph three of the section relating to the proper depth of ballast, page 79 of the Manual, be changed to, "to reduce upheaval by frost," and that the paragraph read as follows:

These depths are required, under the conditions named, to support the track structure to provide good initial drainage; to reduce upheavel by frost; to serve as a cushion for the track.

Appendix B—Revisions in Specifications for Washed Gravel Ballast

The committee sent a questionnaire regarding the specifications for washed gravel ballast and received

and tabulated 50 replies. Eleven of the 15 roads reporting the use of gravel ballast, stated that they are using the association's present specifications in whole or with some modification. Only one of the answering roads suggested changes in substance.

As a result of careful consideration of the answers to the questionnaire the committee rewrote the specifications in order to clarify them and to meet certain objections which were made to the present form, but made no important changes of substance.

The committee reported that it now has under way studies looking toward the development of test methods which will give information covering hardness, abrasion and resistance to weathering. Is stated that tests are also being carried out to determine what gradings produce the least voids and offer the greatest resistance to crushing, and furthermore, that a survey is being made of the practices of the various roads and of the nature of the gravel available for ballast.

Appendix C—Comparative Merits of Ballast Materials

The committee discussed the various kinds of ballast in the order of their comparative merits as arranged in the Manual, as follows: (1) store; (2) washed gravel; (3) slag; (4) screened gravel; (5) pit run gravel; (6) chatts; (7) burnt clay; and (8) cinders.

No. 1—Stone.—Broken stone prepared under the A. R. E. A. specifications is considered the best ballast for heavy high speed traffic. While first cost of application is greater than that of washed gravel, the work required to keep track in line and surface is less than with gravel ballast. Stone ballast is clean and gives better drainage than any other ballast. The length of time between cleaning of stone ballast depends largely on the character of traffic and density. On coal carrying roads, especially near the source of supply, it is frequently necessary to clean stone every three years. In this operation considerable of the stone is salvaged and can be reused. The cost of cleaning ballast has been considerably reduced of late, due to mechanical and improved methods. Stone ballast is dustless which makes it particularly suitable for lines carrying much passenger traffic. It is found that ballast made from stone of good quality is the most economical and satisfactory in regard to track maintenance.

No. 2—Washed Gravel.—This material when prepared to conform to the A. R. E. A. specifications gives a very good ballast for heavy high speed traffic. However, it fouls quickly and cannot be cleaned, it being necessary to replace entirely with new ballast. This material affords good drainage and usually requires renewal in from three to seven years depending on the density of traffic; and on coal carrying roads to the proximity of the mines. The cost of doing the same amount of track work such as surfacing is less in washed gravel than in stone but usually requires more frequent surfacing of track to maintain the same excellence of line and surface.

No. 3—Slag.—Slag ballast consists of two kinds, broken and granulated. The broken or crushed slag ballast varies greatly as to hardness, some slag ballast being the equal of broken stone and the cost of maintaining track on such ballast is about the same as stone. Some slag ballast is soft and disintegrates readily under the action of tamping tools. Such slag ballast soon holds water and is not an economical ballast to use as it retards drainage. Granulated slag is much like sand except that it gives better support and drains better. It fouls quickly where traffic is heavy and frequently cements in large pieces, making it difficult to be worked. Before cementing the ballast is easily worked but under heavy traffic frequent working is necessary. Granulated slag is not considered an economical or desirable ballast to use on main track. Metalliferous slag produced by precious metal smelters has recently been brought to the attention of the committee as making excellent ballast. The committee desires time to further investigate.

No. 4—Screened Gravel.—Practically all gravel ballast that is screened is also washed. Screening alone does not remove the dirt and screening only, unless the deposit is naturally clean, is not an economical proposition. Even where gravel is washed in addition to being screened it has a tendency to creep and work out from under the tie which creates track that is exceedingly hard to keep in line and surface. It is not considered an economical ballast to use except in side tracks and in yards.

No. 5—Pit Gravel.—Pit run gravel varies greatly in quality depending on the grading of the material as to sizes of the aggregates and the amount of dirt and other foreign material, which it contains. This ballast is exceedingly difficult to drain, soon becomes foul, and results in very expensive track maintenance. Where it can be found free of dirt and loam and does not contain an excessive amount of sand, it drains fairly well and gives satisfactory service for light traffic, and makes good sub-ballast.

No. 6—Chatts—Chatts are of two classes, that from zinc ore which is coarse and that from lead ore which is fine. The coarse chatts gives good drainage and is easily worked. Fine chatts make a very dusty ballast, clogs quickly affording poor drainage, requires frequent surfacing especially where traffic is heavy. The use of chatts is naturally restricted to the vicinity of the source and is considered an economical ballast to use where more desirable material is not available.

No. 7—Burnt Clay.—The use of this material as ballast is restricted to a very small area and it is recommended that this item be eliminated from the ballast classification.

No. 8—Cinders.—Cinder ballast consists of locomotive cinders and volcanic ash. The cost of cinders is usually only the cost of hauling material to destination as cinders must be disposed of. When cinder ballast is new it drains well and is easily worked, but disintigrates readily under the action of tamping tools and the impact from heavy loads. It is suitable for ballast on side tracks for lines of light traffic or for track on unstable roadbed. On heavy traffic lines the cost of maintaining cinder ballast is excessive and should not be used. The use of volcanic cinders as ballast material is confined to territory adjacent to the natural deposit. This ballast is heavier and more durable

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than locomotive cinders. It is easily worked and gives very good drainage. Like gravel it cannot be salvaged but has to be replenished from time to time. It is almost dustless and for this reason meets with favor from a passenger traffic viewpoint.

Appendix D—Cause and Effect of Pumping Joints and the Excess of Maintenance Resulting

The committee referred to its report appearing in the 1927 Proceedings. In that report it discussed at some length the various causes and remedies for pumping joints. It was not at that time and is not now able to present any information which would indicate the excess cost of maintenance of pumping joints over the maintenance of joints which do not pump. The only relative costs are approximations based upon the experience and knowledge of trackmen who have both kinds of track. The excess cost of maintaining track with pumping joints is from 2½ times to 4 times the cost of maintaining track which does not have pumping joints.

As a resumé of previous reports the committee called attention to the following causes of and remedies for pumping joints.

(1) Water impounded in roadbed—Provide proper drainage for roadbed, sub-ballast and ballast.

(2) Foul ballast—Either clean the ballast and replace, adding new if required or discard entire foul ballast and provide new, clean ballast.

(3) Creeping rail—Anchor the rail more securely than had previously been done.

(4) Light rail under heavy traffic—Provide heavier rail.

(5) Improper or insufficient tramping—Provide sufficient and efficient supervision for this character of track work.

The committee believes that if the above remedies are applied to the various causes enumerated, the beneficial results will accure or the major contributing causes to pumping joints will be eliminated.

It recently came to the attention of the committee that there is another contributing cause to pumping joints, i.e., the placing of different kinds of ties in the track structure, for instance, where jack pine, tamarack and softer woods are used in the majority with a small percentage of hardwood ties placed at the joints, the latter cause rigidity at the joint which does not exist at other points throughout the rail lengths, thereby creating a pounding at the joints due to the resistance of the hardwood ties.

The committee stated that it had learned further that this contributing cause has been relieved, and pumping joints eliminated by the use of hardwood ties at other points in the rail length than at the joints, using the softwood at the joints.

Appendix E—Shrinkage of Ballast Material

The committee adopted specifications for establishing test sections for determining the shrinkage of ballast under traffic, and attempted to get each road represented on the committee to install test sections according to the specifications. Ten roads agreed to make such test sections, but at the time the committee's report was being written, only four sections were in service. In view of this the committee felt it inadvisable to present results this year and urged that other roads establish test sections during the year so that a comprehensive report can be made next year.

Discussion

[The report was presented by Chairman E. I. Rogers (P. & P. U.) and the recommendations of the subcommittee on revision of the Manual were adopted, following which, Subcommittee Chairman C. B. Stanton (Carnegie Institute) presented the report on Specifications for Washed Gravel. After making minor revisions in the printed report, *it was moved that the recommendations of the committee be accepted for inclusion in the Manual.*]

L. J. Hughes (C. R. I. & P.): I wish to call attention to Paragraph 5, which specifies the rejection of the gravel if the sediment deposited is more than one-half of one per cent. I presume the same percentage is to be carried out in the revised paragraph, although it is not so stated. It has occurred to me that the new revised specification is one which necessarily must be carried out in a laboratory having all the screens called for. The old paragraph called for a test which could probably be carried out readily in the field, although it specified that the amount of sediment should be determined by weight.

I think that the committee should state how a field test can be made which will tell quickly whether or not the gravel meets the specification without having to go to all the trouble of making the exact laboratory determinations called for in the proposed paragraph.

Prof. Stanton: The test shown is the one used as a field test by the Department of Highways of the United States Government. The sizes of the pans are as near the dimensions as possible. This test is now used by practically all the highway departments all over the country as a field test. As to the tolerance, it is apparently an oversight that we did not include it in moving over to the new specification.

R. H. Ford (C. R. I. & P.): I endorse what Mr. Hughes has said. I am apprehensive of these specifications. I am not questioning that these may be excellent specifications for a state highway. In my belief the best ballast is none too good for a railroad. I should like to ask the committee to reconsider the entire specification from the standpoint of securing first-class ballast in a practical manner, with the test so arranged that it will be simple for the field man to determine with reasonable accuracy whether or not he is getting a proper ballast.

Chairman Rogers: This committee will be glad to serve in any manner that it can.

[The committee then withdrew the motion to adopt the specifications and left the matter in the hands of the Committee on Outline of Work to tell it exactly what to do. The subcommittee's report on Merits of Ballast Materials was then presented by Daniel Hubbard (C. & O.).]

E. M. Hastings (R. F. & P.): I direct attention to a statement under heading No. 2, washed gravel, "It fouls quickly and cannot be cleaned." Although I have never cleaned any washed gravel ballast it is my opinion that washed gravel ballast can be cleaned, if it is produced in accordance with the Ballast committee's specification, which I think is an excellent one. It does not foul quickly and it is not always necessary to replace it with new ballast.

Past President J. L. Campbell (N. W. P.): The committee indicates in its report that it has not yet covered the subject of slag resulting from the smelting of the non-ferrous metals. The largest production of slag of that kind properly comes from the smelting of copper ores. I think that is one kind of ballast which the committee ought to investigate quite thoroughly. A great deal of it is being used in the western part of the United States and the Rocky Mountain area. That kind of slag makes first-class ballast.

Chairman Rogers: We have in the past year received some correspondence with reference to that kind of slag from engineers in the western country. In the outline

for future work we have recommended the study of the various kinds of slag.

J. E. Willoughby (A. C. L.): I think the committee is in error in listing slag as No. 3, below washed gravel. Slag is of two kinds; broken slag should be classified with washed gravel, and granulated slag should be in the specification for cinders.

Chairman Rogers: The committee didn't place the various kinds of ballast material in the order in which they are enumerated. That is the order in which they have been on the books of the association for some time and it will be our province in the coming year to see whether or not that order is right.

J. M. Farrin (I. C.): The statement is made that the length of time between the cleaning of stone ballast depends largely on the character of traffic and destiny. I think there should be added the character of the subgrade. Subgrade has more to do with cleaning than either of the others. Farther down in the same paragraph the report states that such ballast is dustless, which makes it particularly suitable for lines carrying much passenger traffic. As a matter of fact stone is not dustless, especially when it is first laid.

The report also states that it is found that ballast made from stone of good quality is the most economical and satisfactory from the standpoint of track maintenance. That depends on the source of the ballast and what other kinds of ballast are available. Further on the report states that pit-run gravel makes good subballast. That leads to a question I should like to bring up as to the combination of the different kinds of ballast. It often serves our needs very well to have ballast of one kind supporting ballast next to the tie. This whole report is a little disappointing in that it appears to be merely an expression of views of the committee without supporting data. This report is distributed all over the world, and it is considered authoritative in nearly every place to which it goes. Therefore, we ought to be careful about sending out information that represents simply the opinion and views of a committee, without any investigation and supporting data.

C. W. Baldridge (A. T. & S. F.): The question of slag ballast was raised. There are four types of slag ballast, one being the precious metal slag. All the precious metal slags I have known are very hard, and make excellent ballast. The next is the open-hearth steel furnace slag. It looks like black glass, breaks up well and makes excellent ballast. Blast furnace slag varies from palpably hard stone to a sponge-like material. This slag is ordinarily carried out from the furnace and dumped over a bank as waste material. If the bank is dry, that side will harden, but if there is considerable moisture under it and the steam reaches it, it will become porous, depending upon the amount of moisture. I have seen blast furnace slag so porous it would float, and so soft that you could break it with your fingers.

The granulated slag, such as is produced at the Gary mills of the Illinois Steel Company, looks like sand, but if rubbed by the fingers it will pulverize like wheat flour. That slag is worthless as ballast or railroad filling material.

A. F. Blaess (I. C.): I should like to take exception to the statement that granulated slag from the Illinois Steel Works is worthless as ballast. We have used it in filling, too. It is excellent.

[There being no further discussion, the report was received as information and the report in the Cause of Pumping Joints was presented.]

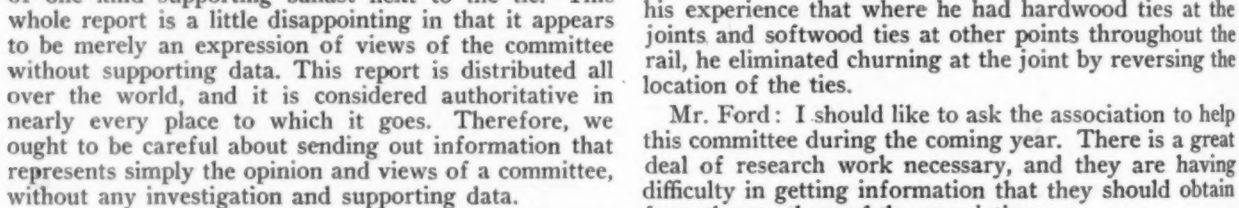
G. J. Ray (D. L. & W.): I am interested particularly in the two paragraphs of this report which state that pumping joints are sometimes caused by hardwood ties placed at the joint when there are softwood ties of woods such as jack pine and tamarack, away from the joint, and that the condition can be corrected by reversing the situation, placing the soft-wood ties at the joint and the hardwood intermediately. If this is a fact, the question is how far to go. Possibly we could get some of these "Mexican sponges" and put them under the joint and solve the problem.

Chairman Rogers: The information contained in those two paragraphs came to the committee from Mr. Cudworth of one of the Canadian roads. It had been his experience that where he had hardwood ties at the joints and softwood ties at other points throughout the rail, he eliminated churning at the joint by reversing the location of the ties.

Mr. Ford: I should like to ask the association to help this committee during the coming year. There is a great deal of research work necessary, and they are having difficulty in getting information that they should obtain from the members of the association.

President Faucette: I wish to say that the Ballast Committee contains 35 members, representing 24 railroads.

[The report was accepted as information and the report on Shrinkage of Ballast was adopted as read, after which the committee was excused with the thanks of the association.]



Santa Fe Station and Fred Harvey Hotel at Needles, Cal.

Report on Uniform General Contract Forms

Committee submits revised form of cost-plus percentage contract and makes progress on other assignments

J. C. Irwin
Chairman

THE reports submitted by the committee covered the following subjects:

(1) Revision of the Manual (Appendix A).

(2) Form of agreement for joint ownership, use and management of a terminal project, collaborating with Committee XIV—Yards and Terminals (Appendix C).

(3) Form of cost-plus percentage and fixed fee in construction contracts (Appendix A).

(4) Form of agreement for purchase of electrical energy in large volume (such as required for traction purposes), collaborating with Committee XVIII—Electricity (Appendix B).

(5) Form of application for industry track (Appendix C).

(6) Form of agreement for use of railway property for public highways (Appendix B).

(7) Form of agreement for wire line crossings, collaborating with Committee XVIII—Electricity (Appendix B).

The recommendations of the committee were as follows:

(1) That no changes be made in the Manual at this time.

(2) That the information on form of agreement for joint ownership, use and management of a terminal project as printed in Appendix C, be accepted as a progress report and that the subject be continued under the title of "Form of agreement for the organization and operation of a joint passenger terminal project."

(3) That the form of cost plus percentage construction contract (Appendix A), be approved for publication in the Manual, and that further consideration be given by the committee to the treatment of cost-plus fixed fee construction contracts.

(4) That the subject "Form of agreement for purchase of electrical energy in large volume" be continued.

(5) That the form of application for industry track (Appendix C), be received as information and for discussion.

(6) That the subject "Form of agreement for use of railway property for public highways" be dropped.

(7) That the form of agreement for wire line crossings (Appendix B), be received as information for discussion.

Appendix A—Revision of the Manual—Form of Cost-Plus Percentage and Fixed Fee in Construction Contracts

No revisions in the Manual were recommended by the committee in this year's report.

In handling the second subject the committee stated that it had reported progress on this subject at the 1927 convention, and at the 1928 convention a contract form was submitted for information and discussion. Since that time intensive study has been given this subject by the committee. Legal advice has been obtained and considered in the preparation of all provisions involving points of law or legal interpretation.

The committee submitted a revised form of cost-plus percentage contract, and in doing so stated that the new form had been drafted with painstaking care. It also said that in preparing the new form, sections from the general form of construction contract, as revised in 1927, had been used wherever applicable. The new form, which covered about nine pages in the bulletin, is not reproduced here.

Appendix B—Agreement for Purchase of Electrical Energy—For Use of Railway Property for Public Highways—For Wire Line Crossings

The committee reported progress on the form of agreement for the purchase of electrical energy in large volume and stated that it had prepared a draft of such a form which was submitted to the Committee on Electricity. In as much as the Committee on Electricity has not acted on the form, the committee did not submit the form to the convention this year, and recommended that the subject be continued.

At the 1928 convention the committee moved that Form of agreement for use of railway property for public highways be dropped, and upon objection raised by members from the floor, the chairman offered to take the subject under consideration again

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B. S. Dickerson, engr. m. w., E. I. & T. H., Washington, Ind.
W. D. Faucette, ch. engr., S. A. L., Savannah, Ga.
F. H. Fechtig, pur. agt., A. C. L., Wilmington, N. C.
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Huntington Smith, off. engr., N. Y. C. & St. L., Cleveland, O.
C. A. Wilson, cons. engr., Cincinnati, Ohio.
John Worley, prof. of trans. eng., U. of Mich., Ann Arbor, Mich.

and this was done. The committee again presented the form for discussion but stated that it was opposed to its adoption by the association for the reason that each such agreement is of special character requiring individual consideration and involving legal questions and questions of title so that a uniform form cannot be established. The committee recommended that the matter of adopting this form be laid on the table.

In connection with the third subject in this appendix, the committee submitted for information and discussion a form of agreement for wire line crossings and recommended that the subject be reassigned.

Appendix C—Agreement for Joint Ownership, Use and Management of a Terminal Project—Application for Industry Track

Under the first subject in this appendix, the committee reported as follows:

The committee collected a large number of contracts covering joint terminals and continued the study of this subject this year. The assignment will be covered by preparation of two forms—one for the organization of a joint passenger terminal company, providing for creation of the railway company to operate and maintain it; the construction of the terminal and the method of financing.

The second form, "joint passenger terminal company—operating agreement," will be made by reference to a part of the first, but can be fully executed only after the terminal company has been legally formed and authorizes its officers to sign the agreement.

The organization agreement has been prepared and approved by the committee. The operating agreement has been drafted but is not yet completed. Both form one agreement and must be considered at the same time. After approval by this committee and complying with our instructions the contracts will be discussed with Committee XIV. It is not possible to present either form of agreement this year, and the committee recommends that the subject be continued.

With reference to the second subject in this appendix, form of application for industry tracks, the committee stated that it had collected a number of forms used for this purpose by various roads in the United States and Canada, and that the information required by the railways was not uniform. During the year the committee prepared a form, requesting information to be supplied by the applicant over his signature, and providing for recommendations of the railway officers required to pass on the application. This form was presented as a part of the committee's report, for information and for discussion.

Discussion

[In presenting the report, Chairman J. C. Irwin, (B. & A.) stated that the only subject recommended for adoption this year is the Form of Cost—Plus Percentage and Fixed Fee in Construction Contracts. It was thought that the committee might prepare a form which would include the provision for a fixed sum and also lump sum, as well as a fixed fee, but it was found, on account of a number of paragraphs in one case that did not apply in the other, that it was absolutely essential to separate it. Subcommittee Chairman F. L. Nicholson (Nor. Sou.) called attention to a few minor revisions which the committee desired to make in the wording and the form, with these changes, *was approved for inclusion in the Manual.*

In presenting the Form of Agreement for the Use of Railway Property for Public Highways, Vice-Chairman E. L. Taylor (N. Y,. N. H. & H.) called attention to the fact that the committee recommended, at the 1928 convention, that this be dropped from the outline of work, but that it had consented to take the matter under consideration again, owing to objections from the floor as to this proposal. The committee, after reconsideration, still opposed such a form agreement, since so many individual conditions are involved that nothing approaching uniformity would be satisfactory. A motion *to drop the subject from the outline of work was carried,* after which the committee was excused.

Report of Committee on Clearances

Recommends assistance of other committees in preparing standard diagram

A. R. Wilson
Chairman

THE committee submitted the following as its annual report for the year 1928:

In order to harmonize the discrepancies now existing in clearance diagrams appearing in the Manual and supplements, and to further develop the subject, we recommend that the committees named below have assigned to them for future work the subject:

Prepare a clearance diagram for recommended practice by which the operation of trains would be affected, with the statement attached as to whether the diagram conforms or conflicts with existing state laws.

Committee I—Roadway; Committee V—Track; Committee VI—Buildings; Committee VII—Wooden Bridges and Trestles; Committee VIII—Masonry; Committee IX—Grade Crossings; Committee X—Signals and Interlocking; Committee XIII—Water Service; Committee XIV—Yards and Terminals.

The committee recommended that its work be continued.

Discussion

[The report was presented by C. W. Baldridge (A. T. & S. F.) who made a brief statement of progress which was accepted without comment, after which the committee was dismissed.]

Personnel of the Committee on Clearances

A. R. Wilson, engr. of bridges, Penna., Philadelphia, Pa. *Chairman*
J. E. Armstrong, asst. ch. engr., C. P. R., Montreal, Que., Can.
C. W. Baldridge, asst. engr., A. T. & S. F., Chicago.
W. C. Barrett, trainmaster, L. V., Sayre, Pa.
H. M. Bassett, gen. office mgr., N. Y. C., New York.
A. T. Hawk, engr. of bldgs., C. R. I. & P., Chicago.
W. E. Hawley, asst. engr., D. M. & N., Duluth, Minn.
F. R. Judd, engr. of bldgs., I. C., Chicago.
J. V. Neubert, ch. engr., m. w., N. Y. C., New York.
W. M. Post, asst. ch. sig. engr., Penna., Philadelphia, Pa.
C. P. Richardson, engr. trk. elev., C. R. I. & P., Chicago.
F. J. Stimson, asst. ch. engr. maint., Penna., Chicago.

Report of Committee on Standardization

Work of this group deals mainly with the internal affairs of association and its affiliations

W. C. Cushing
Chairman

THE report of the committee followed the outline of work submitted and approved in the annual report of the association for the year 1927-1928, and consisted of six parts and four appendices, A, B, C and D.

Part I was a review of the revision of the Manual and consisted of a series of notes with reference to the reports submitted by various committees at the convention last March.

Part II dealt with the extent of use of "recommended practices" by association members, and included the following statements:

An effort has been made to add to the record of information on this subject printed in Proceedings, A. R. E. A., Vol. 29, 1928, pages 69 to 75, but that record stands yet as the most complete general knowledge that we have. However, A. F. Blaess has prepared for the Illinois Central such a complete exposition of the extent of use of each one of the recommended practices of each separate committee that it will serve as a model for similar investigation by other companies.

There are three degrees of use for which the dogma of "recommended practice" are available, or adaptable for appropriation into one's own specifications or instructions:

1. Adoption verbatim, or nearly so, of the plans, specifications, instructions or rules.

2. Incorporation of the fundamental or main items of importance in settling upon and maintaining unification of methods.

3. Acceptance of the general influence of the data and citations in order that one's own practice may be in general accord.

The Illinois Central uses the work of the committees in all of these different ways, and the replies of other chairmen of committees indicate that it is the practice with the railways in general.

It may be looked upon as the part of good membership for any member to call attention to desirable changes in recommended practice which have been made evident by some special experience in the case of a problem or transaction, the investigation and study of which developed a lack of completeness or mistaken conclusion in the practice in vogue.

In Part III, which dealt with industrial and association mutual affiliations in standardization, the committee stated that in the field of standardization, the association's closest affiliations are with the American Society for Testing Materials, the Federal Specifications Board under the chairmanship of the Bureau of Standards, the various divisions of the American Railway Association, and the college engineering laboratories. The report then continued with reference to each of the above named affiliations of the association, outlining matters concerning each which are of particular importance or of interest at this time.

With reference to the American Railway Association, the report said:

This is the official organization through which the railways are enabled to conduct their operations as a unit railway system in cases where their activities expand into national importance from their sectional routine. These major questions are: Standard time; standard code of train rules; block signal and interlocking signal rules; car service; codes of transportation rules (a dozen or more, including track scales); Committee on Relations of Railway Operation to Legislation; Bureau of Railway Economics; Bureau for the Safe Transportation of Explosives and Other Dangerous Articles; railway mail pay; general dimensions of rolling stock; per diem; demurrage; grade crossing safety; standard dimensions of box cars; clearances, and automatic train control.

Harmonizing general railroad practice in dealing with these problems of fundamental importance in the field of railroad transportation is essentially standardization work of widespread value.

In addition to this fundamental standardization, this Association, through the agency of its technical divisions and sections, of which the American Railway Engineering Association is one, is the sponsor of technical and manufacturing standardization of materials of construction appliances and articles so supremely necessary an adjunct in their intelligent purchase and effective application.

Research work has become a vital medium of investigation into economic management and consequent enlarged and improved production in all industrial affairs. In forwarding this valuable work the American Railway Association provides the monetary sinews for the necessary research work in its successful solution. Its annual budget for special investigation is more than 1¼ million dollars.

Since 1907, it has been financing the annual research work of the Committee on Rail, amounting to about $10,000; for several years it has been providing financial assistance, now amounting to $8,000, to the Special Committee on Stresses in Railroad Track, and it contributes $500 to the Committee on Co-operative Relations with Universities. Through the agency of Division VI—Purchases and Stores, as well as of Division IV—Engineering, it has been assisting in bringing to a successful consummation the standardization of classification of lumber.

Following this part of the report there was given a transcript of the report on the standardization of lumber, presented at the annual meeting of the A. R. A. in June, 1928, and also a brief outline of the official make-up of the A. R. A.

With regard to the college engineering laboratory, the report continued as followed:

Personnel of the Special Committee on Standardization

W. C. Cushing, engr. stds., Penna., Philadelphia, Pa.
Chairman

J. R. W. Ambrose, ch. engr., Tor. Term. Ry., Toronto, Ont., Can.
Vice-chairman

J. E. Armstrong, asst. ch. engr., C. P. R., Montreal, Que., Can.
Col. Wm. G. Atwood, cons. engr., New York.
C. W. Baldridge, asst. engr., A. T. & S. F., Chicago.
W. C. Barrett, trainmaster, L. V., Sayre, Pa.
F. L. C. Bond, gen. supt., C. N. R., Montreal, Que., Can.
W. J. Burton, asst. ch. engr., M. P., St. Louis, Mo.
J. M. Farrin, spec. engr., I. C., Chicago.
Robert H. Ford, asst. ch. engr., C. R. I. & P., Chicago.
J. H. Hande, acct. engr., B. & O., Baltimore, Md.
A. T. Hawk, engr. of bldgs., C. R. I. & P., Chicago.
W. E. Hawley, asst. engr., D. M. & N., Duluth, Minn.
J. C. Irwin, val. engr., B. & A. (N. Y. C.), Boston, Mass.
F. R. Judd, engr. of bldgs., I. C., Chicago.
*E. B. Katte, ch. engr. elec. traction, N. Y. C., New York.
C. R. Knowles, supt. water serv., I. C., Chicago.
F. R. Layng, asst. ch. engr., B. & L. E., Greenville, Pa.
J. V. Neubert, ch. engr. m. w., N. Y. C., New York.
W. M. Post, asst. ch. sig. engr., Penna., Philadelphia, Pa.
A. N. Reece, ch. engr., K. C. S., Kansas City, Mo.
C. P. Richardson, engr. trk. elev., C. R. I. & P., Chicago.
E. I. Rogers, ch. engr., P. & P. U., Peoria, Ill.
F. C. Shepherd, cons. engr., B. & M., Boston, Mass.
Earl Stimson, ch. engr. maint., B. & O., Baltimore, Md.
F. J. Stimson, asst. ch. engr. maint., Penna., Chicago.
A. R. Wilson, engr. of bridges, Penna., Philadelphia, Pa.

*Died July 19, 1928.

Besides its scope in the undergraduate curricula, the college engineering laboratory is an agency for promoting the graduate-student development of the engineer graduate, which he must seek to amplify during his entire professional career. It is a workshop for discovering the mechanics of materials with reference to motion, strength, elasticity and energy for the purpose of synthesizing principles of design and construction, of tool and machine creation.

These laboratories have been of especial value in assisting the members of this body to solve the problems of their several spheres of work. There is hardly a committee whose work is not participated in by their professorial representatives. Organized collegiate methods lift haphazard everyday guesswork to the upper level of systematic technical and experimental research; that is, standardization of methods and conduct of attack upon the problem.

Part IV of the report dealt with the newly formed American Standards Association which, during the fall of 1928, grew out of and now takes the place of the American Engineering Standards Committee. This part of the report outlined how this change came about and included a reprint of the revised constitution and by-laws of the new association. The report gave a list of the members of A. R. E. A. standing committees serving as members of the American Standards Association's sectional committees and on committees of co-operating societies.

Part VI of the committee's report referred to the business of national standardization, and consisted almost entirely of highly pertinent and interesting remarks by Calvin Coolidge, W. D. Jamieson and Herbert Hoover.

The main body of the report was concluded with a tribute to Edwin B. Katte, formerly chief engineer, electric traction, New York Central, and a member of the Committee on Standardization at the time of his death on July 19, 1928.

Appendix A

This appendix consisted entirely of a list of the American Engineering and Industrial Standards which have been approved for sale at cost by the American Engineering Standards Committee. This list contains 111 standards, many of which pertain either directly or indirectly to methods or products in the railway field.

Appendix B—Extent of Use of A. R. E. A. Recommended Practices on the Illinois Central

Appendix B consisted of a complete exposition of the extent of the use by the Illinois Central of each of the recommended practices of each of the separate committees of the association. The information in this appendix, which was referred to in Part II of the report, was prepared under the direction of A. F. Blaess, chief engineer of the Illinois Central.

Appendix C—Reorganization of the American Engineering Standards Committee

This appendix contained a formal announcement of the reorganization of the American Engineering Standards Committee for the purpose of enlarging the scope and strengthening the work of industrial standardization on a national basis. It gave in part the minutes of the final meeting of the American Engineering Standards Committee, held on October 11, 1928, and also in part, the minutes of the organization meeting of the American Standards Association, which took place the same day.

Discussion

[The report was presented by Chairman W. C. Cushing, (Penna.), who introduced his report by reading from a recent editorial in the *Railway Age* on, Standards and Purchasing, as follows:]

"There are few persons responsibly associated with large scale buying and supplying who are not agreed upon the importance of employing standards in their negotiations in order to provide the foundation for competition by sellers and the means by which uniformity can be secured in the quality of the product. But the importance of employing standards that are uniform and of adhering to them in practice, does not seem to be so well recognized. A road will go to the expense and trouble to establish a standard to govern the manufacture of a commodity in the open market which will embody some deviation from that adopted by some other road, often just enough to avoid interchangeability, with the result that competition is thereby restricted to the few producers who have templets ready, or the cost is higher than it would be if mass production could be secured.

"To establish a standard, moreover, which purports to be the going standard in a particular branch of business, and then fail to adhere to that standard in purchasing, is as destructive of economy in buying as a failure to adopt a standard. Railroads have been particularly remiss in recognizing this in their lumber buying, although the principle applies equally to other lines of purchasing. It is often recited how a lumber buyer will advertise for prices on a certain grade of lumber and award the business to the lowest bidder, and subsequently learn that if the higher bidders had known, when offering prices, that the buyer would actually accept a lower grade lumber than specified, that grade could have been secured at a much lower price even than was offered by the low bidder who had reaped the advantage of his knowledge of the buyer's practice. Thus it frequently develops in the railway business that competition is not what it could be and prices are not what they should be, simply because the railroad themselves fail to adopt or to follow fundamental principles.

"The value of standards to efficient purchasing has been proved beyond a doubt, but it still remains to be proved that a buyer who does not support the practices which standardization calls for can be depended upon to get the best end of the bargain."

[Mr. Cushing continued in part as follows:]

Your attention is directed to the report quoting the letter of the Department of Commerce in which the A. R. A. was requested to designate a representative to attend a meeting to consider the question of an international agreement on the standard temperature for intercomparison of industrial standards of length. This meeting was not held, as it was found that the matter could be handled by correspondence.

With the acquiescence of a large number of manufacturers and users of gages, gage blocks, etc., and the unanimous opinion that 20 deg. C. (68 deg. F) was the most satisfactory temperature for this purpose, a report was prepared and submitted to the International committee recommending the adoption and use of that temperature for all industrial standards of lengths. Although final action was not taken, the Bureau of Standards considers there is reasonable possibility that it will be approved.

A main object of the report of this committee for this year is to bring out the necessity for industrial management to foster the work of standardization and keep it in its own hands. In this connection, the report presents public statements by the recent President of the United States and the new President of the United States, both emphasizing their beliefs that government must be kept out of business.

[Without further discussion, *the motion was made and adopted that the report be accepted,* and the committee was excused with the thanks of the association.]

Report on Relations with Universities

Committee extends its investigation during the year and reports favorable indications from closer co-operation

R. H. Ford
Chairman

THE work of the committee during the year has been largely confined to broadening its sphere through contacts with other organizations and agencies who are working among colleges and major industries along lines similar to the purpose for which this committee was created; also, in preparing in a more satisfactory manner the mediums through which it will be necessary to work in obtaining replies to the questionnaire to be sent to representative railways, as heretofore recommended.

During the year the committee has been in touch with or represented at conferences of the National Industrial Conference Board, the Society for the Promotion of Engineering Education, the Engineering Foundation, the American Society Mechanical Engineers, the Committee on Public Relations of the Eastern Presidents' Conference, and various other organizations and colleges.

The committee is hopeful that during the coming year it will be able to develop satisfactorily from the executives, principal officers and employees of representative railways, with college or similar training, some of the essential qualifications and preliminary training, education, etc., which the experience of the railways has found to be necessary in recruiting for its service. It is believed that by this means closer co-operation can be obtained between railway managements and the colleges and a greater use made by them of the educational equipment and facilities for research and investigation than at present. Co-operation of this kind offers many attractive possibilities. For example, as an aid in the solution of one of the principal railway problems for meeting the steadily advancing demands of the public for better and cheaper rail transportation, meanwhile yielding a suitable return to the investor in the same manner as for other major industries.

The questionnaire of the committee has already been approved and endorsed by several of the leading organizations which have been engaged in similar studies in other major industries. The committee is hopeful that when the data obtained can be assimilated and studied in the light of other information bearing on the problem, the results will be of great value alike to the railways and colleges. It should make possible a better perspective for our college authorities of the character and extent of the railway field and of the training best suited for young recruits who have natural qualifications and aptitude for the railway service as a career.

As indicative of the foregoing, information has reached the committee during the year from the executive officers of certain railways, which shows in a somewhat striking manner the desirable results evidently being obtained in several of the departments through such co-operation, as well as the value of systematic recruiting on a scale suited to the needs of the service through an established system of selection of young men with a background of suitable college training. While these cannot be taken in any sense as conclusive, they are nevertheless indicative of the advantages that are available to the railways through some co-ordinated plan for a better use of our college facilities.

Discussion

[The discussion consisted of a lengthy expression from W. C. Cushing (Penna.) who, on behalf of the committee, elaborated upon the report of the committee's work during the year by listing educational and business societies which hold meetings from time to time on the subject of relations with colleges; also by giving a list of addresses and papers presented during the past year, on the training of students, which merit study.

Mr. Cushing continued by outlining the action taken at and as a result of the last meeting of the Society for the Promotion of Engineering Education and concluded his paper with an outline of the points to be considered in effecting a feasible plan of training work. His remarks are presented in part as follows:]

It is believed by some of us railway men that there can be considerable improvement in the method of conveying technical knowledge for use in the sciences applied to the arts, so as to equip the student with the fundamental principles which he will be enabled to use with confidence and ultimately become an accomplished engineer, or a skilled technician in the other lines of activity required of the college-trained man in the several departments of a transportation system. Indeed, the occasion for change, provided it brings improvement with it, has been recognized by the college management, and various new methods from new ideas adopted.

I do not wish to see the university becoming a trade school, but hope that it will maintain its distinction as the announcer of scientific facts co-ordinated into fundamental laws for imparting principles, followed by the technical knowledge of their application to the arts, and so equip the coming engineer, or student of other forms of business enterprise, with the groundwork which enables him from that point to start his own intellectual engine in operation and bring forth the new ideas necessary to enable him to solve the problems given him and so become a useful man.

The large difference in the capacities of interviewers for student placement has led to so much dissatisfaction, that various plans for the determination of scholastic aptitude, ability in certain lines of work, and natural appeal for a particular line of study have led to the adoption of many intelligence tests for grading student applicants; and the success of these tests, being of equal importance in industry, has already led large business interests to apply them to their own use.

Placement by an officer from the results of an interview and the appearance of the candidate only has been proved to be unfair to both candidate and employer in many instances.

Personnel of Committee on Co-operative Relations with Universities

Robert H. Ford, asst. ch. engr., C. R. I. & P., Chicago. *Chairman*
J. B. Akers, asst. to vice-pres., Sou., Washington, D. C.
Frederick Bass, prof. municipal & sanitary engr., U. of Minn., Minneapolis, Minn.
G. E. Bates, asst. to vice-pres., D. & H., Albany, N. Y.
G. D. Brooke, gen. mgr., C. & O., Richmond, Va.
J. L. Campbell, asst. to ch. engr., S. P., San Francisco, Cal.
W. J. Cunningham, prof. of trans., Harv. Univ., Boston, Mass.
W. C. Cushing, engr. std., Penna., Philadelphia, Pa.
W. M. Daniels, prof. of trans., Yale Univ., New Haven, Conn.
L. A. Downs, president, I. C., Chicago
J. M. R. Fairbairn, ch. engr., C. P. R., Montreal, Que., Can.
W. D. Faucette, ch. engr., S. A. L., Savannah, Ga.
F. W. Groen, vice-pres., St. L. S. W., St. Louis, Mo.
H. P. Hass, asst. to mech. mgr., N. Y. N. H. & H., New Haven, Conn.
C. E. Johnston, pres., K. C. S., Kansas City, Mo. *Vice-chairman*
E. T. Howson, western editor, Railway Age, Chicago.
M. S. Ketchum, dean, dept. of engr., U. of Ill., Urbana, Ill.
W. H. Kirkbride, engr. m. w. & str., S. P., San Francisco, Cal.
C. F. Loweth, ch. engr., C. M. St. P. & P., Chicago
C. H. Mitchell, dean app. science, Toronto Univ., Toronto, Can.
C. A. Morse, ch. engr., C. R. I. & P., Chicago
A. A. Potter, dean of engr., Purdue Univ., Lafayette, Ind.
G. J. Ray, ch. engr., D. L. & W., Hoboken, N. J.
Henry E. Riggs, prof. of C. E., U. of Mich., Ann Arbor, Mich.
H. R. Safford, exec. vice-pres., M. P., Houston, Texas.
Wm. M. Splawn, pres., U. of Texas, Austin, Texas.
C. C. Williams, dean app. science, U. of Ia., Iowa City, Ia.
W. P. Wiltsee, ch. engr., N. & W., Roanoke, Va.
John S. Worley, prof. trans. engr., U of M., Ann Arbor, Mich.

In addition to the identical interests of the colleges and industry in the development of uniform and effective methods of placement for the particular position under consideration, the main task of the railway is to fix upon an organized plan which will give satisfactory results in the engagement of new men for the different classes of railway work, and there are two separate methods for this accomplishment:

1. Selection by each officer in charge of a division or subdivision of employment.

2. A general personnel department like a civil service commission, reviewing the qualifications of applicants for placement in any one of the divisions or subdivisions.

It is believed that the Pennsylvania has adopted the first plan for this purpose and does not consider the second plan as suitable for railway employment, although it is, to a certain extent, the plan of some of the large industrial establishments.

There might, however, be a certain amount of use for both plans by having each department of the railway company lay down a definite plan of action, which is to a considerable extent done at the present time by the motive power department. In carrying this out, it would be necessary to make a study of the requirements for the employment of college men in order to ascertain the annual number which can be suitably absorbed into the organization and be sure not to obtain too large a number.

A young man who has devoted a certain number of years for a special educational development is ambitious and his main thought when considering employment is his future. He will be much concerned in avoiding an overcrowded condition of that employment which would prevent the possibility of his attainment of his main desire. Lack of opportunity for advancement in employment is the principal reason for causing discontent. An effective plan for dealing with this subject is very desirable in every department which has the employment of college men for various classes of work.

For determining these annual requirements, officers most interested may be delegated to call upon the various sources of employment in order to obtain the recruits desired. Right methods for judging fitness of a recruit are just as necessary in the case of non-technical men as in the case of the college-trained men, and so the problem for railway companies will be something as follows:

First. An effort to outline a method of judging probable capability of a recruit which will strengthen and help to equalize the varied decisions resulting from the personal interview and judgment by appearance. This may lead to:

(A) The personal interview for learning the ambitions and previous training of the candidate from himself.

(B) If college-trained, the possession of his record of scholastic ability.

(C) Possibly, in some cases, the moderate and judicious use of one or more of the "placement tests." If these were made at his college, it might be unnecessary to repeat them.

Second. (A) The railway has the right to know as much of the character, present aptitude from scholastic attainment in a chosen direction, and expectation of possible future progressive development of the recruit as it can obtain in advance.

(B) The candidate for employment has the right to know with reasonable accuracy the conditions in detail of present engagement, and the prospect for continued future advancement as the result of his successfully applied energy and loyal performance.

Trials of plans for training recruits for the purpose of developing their knowledge in the way in which it will be most useful, mutually, to the business in hand have been made and are now being made by railways, but in some cases they have not been successful.

[At the conclusion of Mr. Cushing's remarks, the committee was excused.]

Bridge on the Denver & Rio Grande Western Near Watts, Colorado

Report on Shops and Locomotive Terminals

Committee gives extended attention to coaling stations and locomotive repair shops

A. T. Hawk
Chairman

THE committee presented reports on the following assignments:

(1) Locomotive sanding facilities (Appendix A).

(2) Locomotive repair shops (Appendix B.)

(3) Methods for the safe and convenient storage of crude and fuel oil (Appendix C).

It is recommended: That the report on locomotive sanding facilities be accepted as information; that the heading "Locomotive sanding facilities" be inserted in the Manual, and a reference to the text contained in this report added; (2) That the report on locomotive repair shops be accepted as information; (3) That the report on the safe and convenient storage of crude and fuel oil be accepted for publication in the Manual.

Appendix A—Locomotive Sanding Facilities

The purpose of the committee's report on this subject was to supplement the report on locomotive coaling stations which was presented to the 1928 convention, with the thought that if sufficient data were included in the report to cover the basic requirements of sanding facilities, the specifications adopted for coaling stations could be extended readily to cover these requirements. Following is an abstract of the committee's report:

The basic requirements for locomotive sanding facilities are follows: (a) Capacity of green sand storage; (b) Location of green sand storage; (c) Method of handling green sand; (d) Location, type and capacity of driers; (e) Capacity of dry sand storage; (f) Location of dry sand storage; (g) Method of handling dry sand, and (h) Location for delivery of dry sand to locomotives;

Sand facilities may be separated into various types and combinations, the most frequently used being as follows: (1) Ground storage plant either independent or in conjunction with coaling station; (2) In combination with coaling station a partial gravity plant; (3) In combination with coaling station a complete gravity plant; and (4) Complete mechanical sand plant either independent of a coaling station or in combination therewith.

Type 1—Plants of this type where ground storage of green sand is the distinguishing feature are becoming less popular with the general use of mechanical coaling stations of concrete construction. The extent of capacity for green sand storage is generally small, although in a few instances large installations of this type have recently been constructed at important terminals. Before deciding to use ground storage, however, even where the quantity to be stored is small, careful consideration should be given to the economy of operation as compared with overhead storage, taking into account the cost of handling from cars to storage and from storage to driers, as well as the cost of construction.

Type 2—In plants of this type advantage is taken of the fact that in constructing a coaling station the provision of an additional overhead bin for green sand storage can be made without greatly increasing the cost of the whole structure. Where skip hoists are used sand can be unloaded in the same hopper and elevated by the same equipment as that used for handling coal. This arrangement has the disadvantage of interrupting the unloading of coal while sand is being handled and requires the cleaning of the unloading hopper, both before and after the operation, but if the quantity of sand handled is not excessive and the periods are not too frequent (not to exceed once a week) these disadvantages are more than offset by the elimination of investment in separate facilities. The green sand bin can be arranged to deliver sand by gravity to driers and from driers to sand drum. Elevation to dry sand storage bin also in coaling station is accomplished by compressed air.

Type 3—This type is very similar to Type 2 with the exception that a complete gravity handling is provided from green sand storage to delivery spouts to locomotives. This arrangement is possible where a small green sand storage bin is used and the coaling station is a relatively high and compact structure.

Type 4—Where the handling of coal in a coaling station cannot be interrupted and where the quantity of sand to be handled justifies it, or in locations independent from coaling stations, a complete mechanical sand plant may be used. Such a plant usually consists of an independent hopper for the unloading of green sand from bottom dump cars, a mechanical conveyor of some sort for elevating the green sand, and one or more storage bins of the required capacity. From the storage bins gravity operation through the driers to the sand drum can be arranged. Dry sand is elevated by means of compressed air to the dry sand storage compartment, which may be located in an adjacent coaling station or entirely independent of same.

Green Sand Storage

There seems to be no definite and uniform practice for determining the amount of green sand storage. In some localities deliveries cannot be secured during the winter and frequently even though deliveries can be secured sand freezes in cars before it can be unloaded. This usually means the provision of an independent sand handling plant. Where green sand storage space is provided for in the coaling station structure the minimum space provided should be one carload or at least one week's supply if more than a carload. In an average coaling station of 400 to 600 tons coal storage capacity, it is usually not unduly expensive to provide also for the storage of 100 to 150 tons of green sand.

Handling Green Sand

It is the usual practice in Type 1, or ground storage plants, to use laborers with wheelbarrows for the delivery of green sand to the driers. The cars are unloaded either by hand shoveling or with a clam shell bucket on locomotive or some other type of crane. Where Type 2 or Type 3 plants are used the coal elevating equipment can be used also for sand, where such equipment is of the skip hoist type, by placing temporary choke over loader opening and partially filling the bucket. Continuous bucket conveyors designed for coal cannot be used for sand without serious overloading on account of the difference in weight of the two materials and in such installations a separate conveyor for sand handling is required.

Driers

Sand can be dried successfully in either stove or steam driers. Where steam supply is available from central shop power plant, it is usually considered good practice to use steam driers as they can be operated without so much manual attendance and the fire hazard is also reduced. In any case, building or compartment housing driers should preferably be entirely of fireproof construction. Sufficient drier units should be provided to keep an adequate supply of dry sand on hand at all times.

Dry Sand Storage

The capacity of dry sand storage bins varies considerably in actual practice, capacities ranging from 10 to 25 tons being generally used. The capacity selected for a given location should be sufficient to permit the establishment of a generous reserve for use during any unavoidable interruption in the operation of the drier. When facilities are constructed in connection with a coaling station, dry sand storage compartment

can be provided readily at some convenient location in that structure.

Handling Dry Sand

The generally accepted method of handling dry sand from drier to storage bin where gravity cannot be employed is by means of compressed air. In this method sand from the drier is collected in batches of approximately one cubic yard in a sand drum, and air pressure is then applied. Usually 2½-in. pipe is used to convey sand from sand drum to storage bin. At points in pipe line where direction is changed, it is good practice to use heavy tees with one tee opening plugged, thus forming a pocket which fills with sand for deflection purposes. Dry sand storage bin whether located in coaling station or independent of same should be placed at such an elevation that sand will readily flow by gravity to delivery fixtures. In cases where a large number of tracks are to be served it is sometimes necessary to provide two dry sand storage bins. Sand outlet fixtures for delivery to locomotives should be of the telescopic, counterbalanced type and equipped with weatherproof valves.

Appendix B—Locomotive Repair Shops

In the introductory paragraphs of its report, the committee called attention to the progressive growth in the size of shops and equipment used in connection with locomotive repairs, and referred to diagrams which accompanied the report, illustrating typical shops built during the period from 1900 to 1928. Abstracts from the report follow:

In the longitudinal shops, attention is called to the increased spacing of repair tracks, wider and higher erecting and machine bays and increased capacity of cranes; in the transverse shops, the width and height of erecting bay and the capacity of cranes. In both types of shops a feature of considerable importance is the increase of shop area provided for machine shop purposes.

Some of the older shops have been improved to handle the heavier motive power. These improvements, while of great help, cannot take the place of properly designed modern shops. Lack of proper facilities usually results in a shortage of power or necessitates the purchase of additional locomotives in order to supply adequate service, and also results in an increase in the cost to maintain power.

The new shop constructed today will be continued in service for at least 25 or 30 years and should be so arranged that it may be conveniently enlarged and at the time built should be large enough not only to take care of the largest locomotive on the line of road today, but sufficiently large to take care of any reasonable increase in size of power.

After reference to the increased wages of skilled and common labor, the report continued: All practicable means of eliminating manual labor should be utilized. Probably the greatest step in this direction is the overhead traveling crane; individual jib cranes; trucks, tractors and trailers for material handling.

Size of Shop—Assuming a properly balanced shop—the output of a shop is determined by two factors: (a) Number of spots provided in the shop; and (b) Average length of time required in shop by each locomotive.

The average time must be determined from the conditions on the individual railroad. Generally speaking, the average of most railroads seems to be one and one-half locomotives per month per spot, depending upon the type of power, the proportion of the different classes of repairs, and the extent to which adequate repairs and handling equipment has been provided.

In order to get the opinion of those now operating large shops of old or modern design, a questionnaire was prepared and sent out to which replies were received from 25 roads, one locomotive manufacturer and one architect. This questionnaire asked, in most instances, for a preference of stated design, and brought out replies which, in some cases, were not a direct answer to the question. This variation prevents giving the replies in table form.

Type of Shop—There are two distinct types of locomotive repair shop; the transverse shop and the longitudinal shop. The question of whether to adopt a longitudinal or transverse type of erecting shop has been the source of more discussion than any other subject connected with the layout of locomotive repair shops. Each type of shop has its merits and the adoption of one type over the other will depend primarily on three considerations, namely: personal preference; property restrictions; and the possibility of radical change in length of power to be maintained.

Several recently constructed large shops have been of the transverse type, a fundamental advantage of this type is the right angle movement resulting from the cranes operating crossways of the track, which permits a better distribution of material and work between the engines and the machine tools, and also allows a better grouping of supervisory forces and workmen. The longitudinal shop is better adapted to the "station to station" system of repairs, and can be better adapted to radical change in length of locomotives.

Longitudinal Shops—In the longitudinal type of shop there are three types of cross section of the erecting or repair bay: (a) Equipped with one level crane runway; (b) equipped with one level crane runway and traveling jib cranes along column rows beneath; and (c) Equipped with cranes on two levels.

In modern shops the erecting bay varies from 90 to 100 ft. wide with three repair tracks spaced 30 ft. centers. In most shops the track pits extend practically the full length of the shop.

The crane equipment in the erecting bay consists of two cranes of sufficient capacity and high enough to move engines down the shop when suspended between others on the tracks. In addition to the heavy cranes, lighter cranes on lower runways are provided for stripping and messenger service.

Transverse Shop—In the transverse type of shop there are three types of cross-section: (a) With a total absence of crane service; (b) Equipped with one-level runway; and (c) Equipped with cranes on two levels.

Type (a) is served by ladder tracks or a transfer table. Type (b) and (c) may be served by a transfer table, one or more entrance tracks or turntables as ground conditions or track arrangements will permit.

Where a transfer table is provided, the high-level, two-trolley cranes may be of capacity and height to lift unwheeled engines over others standing on the floor. In shops where one or more entrance tracks are provided, the high level crane must be of capacity to transport a wheeled engine clear of others on the floor. The stripping cranes are usually 15-ton capacity.

Combined Transverse and Longitudinal Shop—Recently the progressive system of shop operation has not only been given serious consideration but in some instances adopted. Inasmuch as certain repairs cannot be made without disturbing the progressive order of other repairs and are best made on separate spots, it would seem that a combined transverse and longitudinal shop would be best adapted to this method of operation. This will permit the repairs, common to all locomotives, to be done in the longitudinal bay under the progressive method while the additional work incidental to the different classes of repairs can be done on a fixed position in the transverse portion without interference with movement of locomotives in the

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progressive system. It would permit the least handling of parts between the locomotive and the various shop departments.

Following the publication of the questionnaire sent out, together with a summary of the replies received, the report continued:

After reviewing the different replies to the questionnaire, it is our opinion that committee is not justified in laying down any fixed rules as to the type and size of shop to be recommended by the A. R. E. A. It is thought that certain principles involved are common to every railroad and that, before a shop is planned, there should be a definite knowledge of what the shop is expected to do. In view of this feeling an additional questionnaire or report of inspection of locomotive repair shops has been prepared which, we think, would contain the data which should be known by any railroad desiring to erect a locomotive repair shop. Then their own problems can be compared with the collective data of railroads operating shops similar to those they desire to build.

Building Construction—The cross section of the building is determined by the crane heights and loadings. The wheel loads of the heavy cranes are much greater than those of the heaviest locomotives and careful assumptions must be made of loadings and side and end thrusts to provide a structure which is both safe and economical.

The varying heights of the different bays give an excellent opportunity to use continuous steel sash between roofs of different levels. These can be supplemented by skylights over the erecting bay and longitudinal sawtooth lighting over the lower bays. An alternate to these roof lights can be made by building alternate roof panels on the top and bottom chords of the trusses with continuous top hung steel sash alongside of the trusses.

Side and end walls of brick, anchored to the steel work, with steel sash grouped in large units provides the most satisfactory enclosure of the building. All movable sash and ventilating panels should be glazed with wire glass; fixed sections of side wall sash may be glazed with clear or plain ribbed glass. Glare and direct sun rays should be guarded against.

Floors of wood block on a concrete base have proved satisfactory for the heavy shop service. In some departments, floors of asphalt block or cement finish can be used. Swinging wood doors for tracks and other large openings are the most economical and quickest in operation.

Appendix C—Storage of Crude and Fuel Oils

OIL PUMPING PLANTS

The committee's earlier investigation, as reported to the association in 1924 and printed in the Proceedings for that year (Volume 25, pages 66 to 95), showed that steam driven piston pumps were in general use by oil-burning railroads for pumping oil. There has been since that time an increasing use by some roads of electric driven centrifugal pumps which are considered more economical under certain circumstances.

In view of this change which has taken place, the committee included in its report a discussion of the factors to be considered in determining the economical plant for a particular installation. This part of the report dealt with: (1) The possible saving in wages through automatic operation; (2) delivery by gravity or under direct pump pressure; (3) heating requirements; (4) available power; and (5) suction level.

The committee also recommended that certain revisions be made in paragraph 5, with regard to fire protection, as printed in Bulletin No. 278, page 83, Supplement to the Manual.

Discussion

[The report was presented by the chairman, A. T. Hawk (C. R. I. & P.), who asked L. B. Kimball (B. & O.), subcommittee chairman, to introduce the matter in Appendix A on Sanding Facilities.]

Mr. Kimball: While it is difficult to prepare definite specifications on sanding facilities, there are certain combinations of facilities and equipment which are being used successfully on different railroads, and the purpose of this report is to place the information before the association as information.

Chairman Hawk: The next report will be submitted by Mr. Radspinner, the subject being Locomotive Repair Shops.

W. A. Radspinner (B. & O.): I desire to call your attention to some of the points brought out by the committee in its investigation. In order to get the opinion of those now operating large shops both of old and modern design, a questionnaire was prepared and sent out to representative companies in the United States and Canada, to which replies were received from 25 railroads, 1 locomotive manufacturer and 1 architect. This questionnaire asked, in most instances, for a preference of stated design, and brought out replies which, in some cases, were not a direct answer to the question. This variation makes it impossible to give the replies in table form, but it is thought well to include some of the comments. The information in regard to combined transverse and longitudinal shops was not developed until after the questionnaire was submitted and replies received. The transverse type of shops was favored over the longitudinal type by a vote of 20 to 6.

Most of the replies agree on the material for floors, the type of power houses and the systematic installation of water, air and electric lines, but in the distribution of floor space there was considerable difference of opinion. One of the answers which appealed to the committee particularly was the recommendation by several railroads that the amount of space required should be determined only after careful study is made of the requirement. It was stated that:

"A suggested solution of the problem is to consider the type of locomotives which are to be repaired, making ample provision for repairs to the locomotive proper, and in addition, to all of the modern accessories used. A careful time-study should be made of all the machine tool operations, then allow sufficient space in the building to take care of the required machinery. On this principle the entire size of the shop depends.

"The rate at which locomotives must be turned out of a shop to produce a given monthly output is found by dividing the total working hours per month by the desired output. The rate of output applies to every major operation, therefore, sufficient machinery must be available to turn five pairs of driving wheels, bore ten driving boxes, etc., in the allowable time, otherwise the shop will not be balanced."

The principle stated in this answer is probably the best work of the committee. It is thought that considerable study of the application of this principle should receive attention for future study, and it is recommended that the committee continue its work of investigation. Recommendation is made with the idea of not suggesting a standard, but bringing before the association the best practices of modern locomotive repair shops.

Chairman Hawk: Appendix C, Methods for the Safe and Convenient Storage of Crude and Fuel Oils, will be presented by J. M. Metcalf (M-.K-.T.).

[Mr. Metcalf presented the report and *his motion that it be adopted was carried.*]

Mr. Radspinner: In connection with the report on Locomotive Sanding Facilities, the committee desires to recommend that the Manual, which now contains the specifications for locomotive coaling stations, be revised in so far as the paragraphs for sanding facilities are concerned, to include a reference to this report. *I so move.*

[*The motion was carried and the committee was excused with the thanks of the association.*]

Report of the Committee on Ties

Many measures to bring about great crosstie life are discussed

W. J. Burton
Chairman

THE report of the committee covered the following subjects:

(1) Revision of Manual (no recommendation).

(2) Anti-splitting devices (Appendix A).

(3) Extent to which specifications are being adhered to (Appendix B).

(4) Renewal of switch ties (Appendix C).

(5) Report on substitute ties (Appendix D).

(6) Method of marking ties to indicate acceptance (Appendix E).

(7) Method of tie acceptance inspection (Appendix F).

(8) Traffic unit for use in comparing crosstie life (Appendix G).

(9) Report data on renewal averages per mile of maintained track (Appendix H).

(10) Definitions of species of wood included in standard specifications (no report this year).

(11) Size of hole preboring (Appendix I).

The committee recommended that Appendices A, D, E, F and H be accepted as information and that the subjects be continued; that the report in Appendix G be adopted and the subject be discontinued; that the report given in Appendix B be received as information and the diagram in this appendix be included in the Manual as part of the specifications for crossties; that Appendix C be adopted and that the portion indicated be included in the Manual; and that Appendix I be adopted and the recommendations incorporated in the Manual.

Appendix A—Anti-Splitting Devices

The work of the committee this year included the beginning of a study of the behavior of the anti-splitting irons and the ties through the period of the natural seasoning. Three forms of irons are being watched on four kinds of wood in sizes 4 and 5 ties.

For this test, "C" irons, "S" irons, and a patented iron are being used. The ties are white and red oak, white birch and hard maple. Ties were selected which showed incipient checking. These ties were assembled at the Burnside shops of the Illinois Central where the tests are being conducted with the ties exposed to the weather.

Photographs were taken of the ends of each tie immediately before and after the application of the irons, and photographs will be taken at about 30-day intervals throughout the test. A few ties of each kind of wood were not ironed, and will serve for comparison.

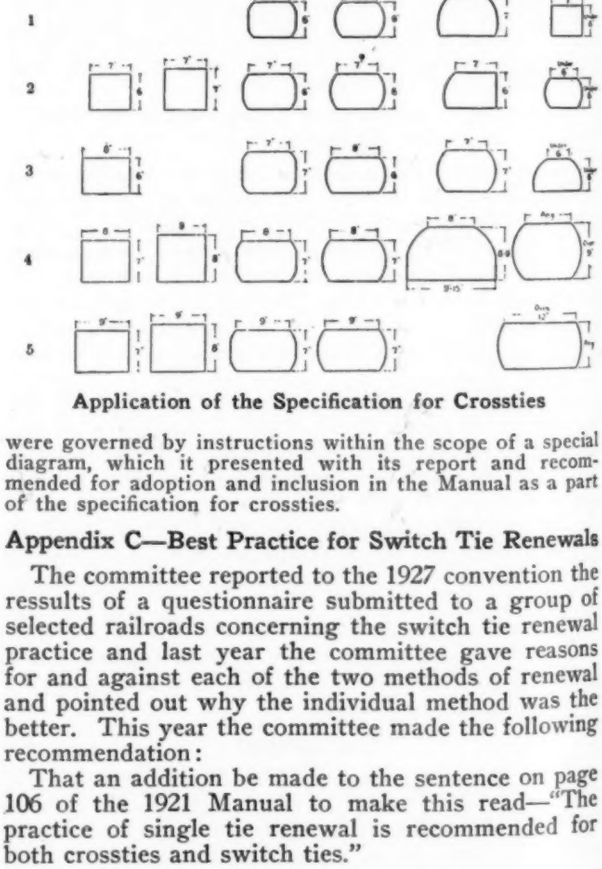
The committee also has under consideration a device to measure the force exerted by the splitting tie during the seasoning period. The results should indicate whether this force is sufficient to become a factor in the design of the anti-splitting device or whether the latter; if made strong enough to permit driving, will not then be amply strong to resist the tendency of the tie to split.

Appendix B—Adherence to Specifications

The committee inspected the ties at three commercial wood preserving plants in the vicinity of St. Louis. Over a million crossties of hardwoods (mostly oak) and of southern pines provided examples of the inspection given by eight roads in Arkansas, Illinois, Mississippi and Missouri.

These ties in general showed closer adherence to standards than was the case when ties were examined at two of the plants in 1925. There was less decay present in the accepted ties than was the case three years ago. This improvement is encouraging, and adds to the proof on every hand that crossties in accordance with the standard specifications are to be had by any railroad which is not careless or reckless.

The few railroads owning the bulk of the ties represented among those observed varied only slightly in their application of the standard specification to the inspection of ties with reference to their size. The committee said that differences due to variations in practice when deciding the standard sizes at which ties of unusual shapes or of excessive dimensions are acceptable result in a lack of uniformity which would be remedied to a great extent if inspection



Application of the Specification for Crossties

were governed by instructions within the scope of a special diagram, which it presented with its report and recommended for adoption and inclusion in the Manual as a part of the specification for crossties.

Appendix C—Best Practice for Switch Tie Renewals

The committee reported to the 1927 convention the results of a questionnaire submitted to a group of selected railroads concerning the switch tie renewal practice and last year the committee gave reasons for and against each of the two methods of renewal and pointed out why the individual method was the better. This year the committee made the following recommendation:

That an addition be made to the sentence on page 106 of the 1921 Manual to make this read—"The practice of single tie renewal is recommended for both crossties and switch ties."

Appendix D—Substitute Ties

The committee again presented a summarized statement of the record of tests on substitute ties

being used by a number of roads, and added to the ties previously under observation, a new type of reinforced concrete tie, called the Duke reinforced concrete tie, which is being tried out on the Atlanta and West Point railroad. It also took under consideration a new installation of Silver combination steel-concrete ties on the Pennsylvania.

ELECTRICAL CONDUCTIVITY OF CONCRETE CROSSTIES

The following information relative to the reduction in the resistance of signal track circuits in recent extensive installations of Casey or Brown ties in use on the Pennsylvania, was supplied by W. C. Cushing, Engineer of Standards, of the Pennsylvania.

We have begun to receive reports from our signal maintainers that the resistance for signal track circuits has been greatly reduced, thus requiring shorter circuits with consequent additional expense.

First Case.—In a track circuit 4,400 ft. in length, there are 1,985 concrete crossties and 500 wood ties, the latter being largely in the center of the section. Before the concrete ties were put in the ballast resistance was 12.3 ohms per thousand feet. After placing the concrete crossties, readings taken under the same climatic conditions showed the resistance to be 1.1 ohms per thousand feet, and it was necessary to cut the section in the center in order to get sufficient current at the relay end to operate properly in wet weather. This is an additional expenditure of $800.

Second Case.—In a track circuit 2,650 ft. long with 1,028 concrete crossties and 479 wood ties, and another one 1,750 ft. long with 945 concrete crossties and 21 wood ties, with clean ballast and track in good condition, it is estimated from measurements made that for minimum total ballast resistance of 0.4 ohm for the track circuit, the maximum length of concrete crossties should not be over 2,400 ft.

Third Case.—Another independent observer found that a 2,800-ft. circuit gave a resistance of less than 0.2 ohms about the failing point for the circuit, as the relay was just about shunted by the track leakage.

These reports seem to be important in connection with experimental trials of concrete crossties.

Appendix E—Grading Marks for Ties to Indicate Acceptance

The committee's report consisted principally of a questionnaire which it has submitted to various roads to develop the present practice with regard to grade marks for ties. It stated that the results of its questionnaire will be incorporated in its report for next year.

Appendix F—Methods and Rules for Tie Acceptance Inspection

The committee assigned this subject merely included in its report a questionnaire which it has sent out to a number of roads, and stated that the data which will be received will be assembled, and that definite recommendations will be developed.

Appendix G—Traffic Unit for Use in Comparing Crosstie Life

Following is an abstract of the report of the committee on the above subject:

This committee has previously attempted to work out a unit by which the effects of traffic on the life of crossties can be equated for use in comparison between individual roads. It is the thought of the committee that the average cost of tie renewals per maintained mile, so adjusted for differences in average traffic, will give results as nearly comparable as the character of the data and the variables involved will permit.

In selecting the recommended unit, consideration has been given to available statistics, but too great refinement has been avoided. If a road has only freight traffic, the proper unit would probably be freight "gross-ton-miles" and while, on the majority of roads, the proportions of freight and passenger traffic are generally similar, yet there are some cases where the proportion of passenger traffic is greatly dissimilar from that of the average railroad. The committee has therefore felt it desirable to use a unit which will reflect passenger, as well as freight, traffic. The unit recommended is a combination of freight gross-ton-miles, including locomotives, and passenger gross-ton-miles, including locomotives.

Freight gross-ton-miles is readily available and can be obtained conveniently for each Class 1 road from the summary of operating statistics issued by the Bureau of Railway Economics. Passenger gross-ton-miles is not readily available from any report and the committee therefore recommends its estimation, unless the actual is known, by assuming the average weight of passenger cars, this average to be multiplied by the passenger car miles to give passenger car ton-miles. In the absence of a closer figure, the committee recommends 72 tons as determined by the Mechanical Division, A. R. A. This figure of 72 tons may be somewhat high for light passenger trains.

Passenger locomotive ton-miles is not available, therefore, as an allowance for passenger locomotives, the committee recommends the addition of one-third to the total passenger gross-ton-miles. As an allowance for speed, the committee recomemnds a factor of 1½; or in other words, assumes that it takes 1½ ton-miles of freight, including locomotives, to equal 1 ton-mile of passenger, including locomotives, as regards the damaging effect on ties.

The adjusted traffic is therefore the sum of freight gross-ton-miles, including locomotives, and passenger gross-ton-miles, including locomtives, as estimated above, with the passenger gross-ton-miles increased by 50 per cent as an allowance for speed. This formula can be expressed algebraically as follows:

Adjusted traffic = Freight gross-ton-miles plus passenger car miles × 144

Traffic Density Unit = Adjusted traffic divided by miles of maintained track—or,

Traffic Density Unit = Freight gross-ton-miles plus passenger car miles multiplied by 144 and the sum divided by miles of maintained track.

This formula is in reality quite simple and the necessary figures can be obtained from the summary of operating statistics—Class 1 railroads, issued monthly and yearly by the Bureau of Railway Economics.

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Appendix H—Data on Average Ties Renewed Per Mile of Maintained Track

The report of the committee pointed out that, on the request of the committee, Schedule No. 513 of the annual reports of the Interstate Commerce Commission was modified to include the essential data to ascertain the average ties renewal per mile of maintained track on the various roads. From the data compiled by the commission, two tables were compiled and made a part of the committee's report; one showing the crossties laid in replacement on the leading roads in the United States during the year ending Dec. 31, 1927; and the other, derived from the first table, showing the wooden crossties laid in replacement (treated and untreated) on the leading roads in the United States during the year ending Dec. 31, 1927.

Appendix I—Size of Holes for Pre-Boring

A canvass of railroads two years ago by the committee indicated that there was some variation in practice as to size of holes bored for certain sizes of spikes. It was found, however, that most roads bore $\frac{1}{16}$ in. smaller than the spike in hardwood ties and $\frac{1}{8}$ in. smaller in softwood ties, although in the case of roads using a $\frac{5}{8}$-in. cut spike in hardwood ties the practice was almost evenly divided as between the $\frac{1}{16}$-in. smaller and $\frac{1}{8}$-in. smaller. All roads boring for screw spikes bore the hole the same size as the core of the spike with one exception and this road used 1/32 in. less than the core of the spike in pine ties. Most of the roads bore entirely through the ties.

Conclusions

(1) Because it is very difficult to make chisel-pointed spikes follow ¼-in. and ⅜-in. holes, the committee concludes these sizes are too small for practical use.

(2) In hardwood ties, using $\frac{7}{16}$-in. by 6-in. cut spikes, the $\frac{7}{16}$-in. holes give greatest resistance to vertical pull; using $\frac{5}{8}$-in. by 6-in. cut spikes, ½-in. holes give greatest resistance. In softwood ties, the $\frac{7}{16}$-in. holes give greatest resistance to vertical pull with both $\frac{7}{16}$-in. by 6-in. and $\frac{5}{8}$-in. by 6-in. cut spikes.

Comparing untreated, creosote treated and creosote-petroleum treated ties, the resistance to vertical pull is greatest in the untreated and least in the creosote-petroleum treated. In all woods tested, the load required to start the spike was the maximum load.

(3) In hardwood ties, using $\frac{7}{16}$-in. by 6-in. cut spikes, the $\frac{7}{16}$-in. holes give greatest resistance to horizontal thrust; using $\frac{5}{8}$-in. by 6-in. cut spikes, the $\frac{5}{8}$-in. holes give greatest resistance.

In softwood ties, using $\frac{7}{16}$-in. by 6-in. cut spikes, the $\frac{7}{16}$-in. holes give greatest resistance to horizontal thrust; using $\frac{5}{8}$-in. by 6-in. cut spikes, there is little difference between the ½-in., $\frac{7}{16}$-in. and $\frac{5}{8}$-in. holes.

(4) Disturbance of the wood fibers is much less where spikes are driven in holes $\frac{7}{16}$ in. in diameter or larger. In general there is the least damage to the fiber when the largest size holes are used.

(5) Spikeholes should be bored entirely through the ties except in the case of ties for use in direct current electric lines having covered track. Under such conditions it has been found that spikes corrode badly due to electrolysis when the spike holes are bored entirely through the ties.

(6) The chisel-pointed spike is not altogther satisfactory for driving into bored holes because of the tendency of the sharp corner to lead the spike away from the hole. The committee is of the opinion that the type of spike point for driving into bored holes should have further study.

(7) The committee is of the opinion that at least equal weight should be given resistance to horizontal thrust as compared to resistance to vertical pull, when considering this question. Consideration should also be given to the fact that disturbance of the wood fibers is least in the larger sized holes.

Recommendations

(1) That ½-in. holes be bored in hardwood ties for $\frac{7}{16}$-in. cut spikes.

(2) That $\frac{7}{16}$-in. holes be bored in hardwood ties for $\frac{5}{8}$-in. cut spikes.

(3) That $\frac{7}{16}$-in. holes be bored in softwood ties for $\frac{7}{16}$-in. cut spikes.

(4) That ½-in. holes be bored in softwood ties for $\frac{5}{8}$-in. cut spikes.

Discussion

[The report was presented by the chairman, W. J. Burton (M. P.) and the subcommittee reports on Anti-Splitting Devices, and Adherence to Specifications were received as read. The report on Switch Tie Renewals was then presented by Subcommittee Chairman W. C. Bolin (B. & O. C. T.) *and it was moved that the recommendations be accepted for inclusion in the Manual.*]

A. F. Blaess (I. C.): The proposed revision reading: "The practice of single tie renewals is recommended for both crossties and switch ties," should be given further consideration before adoption for inclusion in the Manual.

For a great many years it has been the practice on the Illinois Central to renew main track switch ties out of face. When such renewals are made, all ties relieved that have additional service life are reinserted in making repairs and renewals of switch ties on inside tracks. It is our judgment that we have been able to maintain a much better riding condition over main track turnouts without increased cost than would have been possible had the turnouts been disturbed in several different places for the purpose of making individual tie renewals. In renewing a set of switch ties out of face, it is the general practice to give the turnout a general resurfacing, obtaining a uniform bearing and surface throughout.

The statement made in the report to the effect that ties taken out when a set of switch ties is renewed out of face are not utilized, is not correct. In my judgment this is a matter of supervision, and by proper inspection and supervision there is no good reason why ties which have been removed from the main track and still have some service life cannot be used to advantage on inside and less important switches. In some instances ties under frogs and the head blocks need renewal more frequently than the remainder of the ties in the set, and in such cases it is desirable to replace them without renewing the entire set.

Chairman Burton: The preponderance of practice by mileage or by a count of roads, or any other method, means very little. One individual road may perhaps have a better practice than the majority of the roads. In the past the committee, in connection with questionnaires, has paid more attention to roads which have made recent changes rather than to the greatest number following a given practice. The relative merits of the two practices were studied two or three years ago, but in view of the fact that the Illinois Central may have some additional information the committee will be glad to reconsider the subject if that is the wish of the Board of Direction.

President Faucette: Under the circumstances, we will refer it now to the Committee on Outline of

Work, with the request that it take under consideration the remarks made by Mr. Blaess.

[The reports of the subcommittee on Substitute Ties and Rules for Tie Inspection were then presented and accepted, following which the report on Tie Life was presented by A. F. Maischaider (C. C. C. & St. L), who moved that the report be adopted.]

R. L. Cook (C. of Ga.): I should like to have an explanation of the formula. It is an important formula if we are going to apply the table that is given, and it may raise some very embarrassing questions.

Mr. Maischaider: We equated the traffic unit to the freight gross ton miles, including the locomotive. That is the largest unit that most railroads have. The passenger cars are added on the basis of 72 tons per car, which is a figure developed by the Mechanical Division of the A. R. A., and we equated the passenger locomotive as one-third the weight of the train. That seems to be the fair average on most roads by actual check. The factor 144 is 72 tons to the car, adding one-third for the weight of the locomotive, multiplied by 1½ for the speed effect, which is equivalent of 72 times 2.

Mr. Cook: The suggestion of the committee, that the effect of use upon crossties is different in the case of treated and untreated ties, inclines me to agree with the suggestion that a percentage of 30 is representative in one case and 50 in another, and yet I understand from this report that it is not the intention of the committee to consider that in the application of the formula.

Chairman Burton: The committee is working with statistics originating with reports to the Interstate Commerce Commission on ties renewed. Those reports show the kind of ties put in but do not show the kind of ties taken out, so it is not possible with the data available to differentiate between treated and untreated so far as ties taken out of track are concerned.

G. J. Ray: (D. L. & W.): The committee is to be commended on trying to arrive, and actually arriving, at some sort of formula. There is, however, some doubt in my mind as to the results which will come from these comparisons. If you check the average speed of passenger trains on many lines west of the Mississippi river, you will find the average speed of a great deal of freight service between Chicago and New York in the eastern territory is fully as high. It is my observation, or it has been, that it is easier to maintain track under passenger service than it is under freight, the speeds being equal. Locomotives that pull our freight trains at higher speeds are doing as much damage to the ties and all other parts of the track, if not more, than passenger engines running at the same speed.

I doubt that you will get a very valuable comparison on that account. You will find that on many of the eastern roads, the fast freights are moved at an average speed of 30 to 35 miles an hour over the entire area and travel at very much faster speed than that. Our freight trains run 50 miles an hour all the time.

There is another thing, as far as weight is concerned, with regard to this comparison of passenger cars. Take the weight given, 144,000 lbs., that is the weight of cars in heavy passenger service. On a suburban railroad where cars are run which average much less in weight, you are going to have the mileage and you are going to get that mileage into this formula. On my road we have a great many miles of that service. I question whether your results are really going to be worth very much.

J. E. Teal (C. & O.): I was wondering if the committee would consider using a formula of high speed. Also, why not use the actual figures instead of an arbitrary one?

Mr. Maischaider: The second part of Mr. Teal's suggestion is contained in the report. The difficulty with the first part of the suggestion is that we are of necessity dealing with system figures. The average speed of passenger trains would depend upon how you arrived at that average. It would be one thing doing it one way and another thing doing it another way.

Paul H. Metcalf (N. Y., N. H. & H.): I am under the impression that we had previously adopted a formula for that, for the comparison of maintenance expense differs somewhat from this.

Chairman Burton: The question was raised last year why we didn't use the formula developed in 1925, but that formula required certain figures that are not available, and the formula that we have developed now is easily arrived at.

Richard Brooke (C. & O.): The discussion has brought out, I think, that the committee is attempting to develop a traffic measure in comparing the life of ties. I think it is important that they take into account the use of treated ties on a given railroad in comparing it with some other road. Mention was made of the New Haven. I have understood, I may not be right, that that road has not been treating its ties very long. That would easily account for the heavy renewals as compared with some other road that has been using treated ties. I would suggest that the committee accept the subject for further consideration another year.

Past President J. L. Campbell (N. W. P.): It seems to me the criticism, which, I think is well taken, would be met by stating this formula in general terms, so that each road could assign to the various factors the proper value, as they would determine it from their own experience.

Mr. Maischaider: Whether the ties in the track are largely treated or untreated does not have any effect on the formula of stating the tonnage or the density of traffic.

Mr. Brooke: It does have that application, however. It appears that the committee is simply trying to use statistics which are available in the I. C. C. statistics. If that is the case, they should use the same unit that the Committee on Economics of Railway Operation used formerly, and probably use the same application, which, I believe was 55 per cent.

[*The motion to adopt the report for inclusion in the Manual was put to a vote and lost.*

The report on Tie Renewal Data was accepted and the report on the Size of Holes for Preboring was then presented by R. S. Belcher (A. T. & S. F.) *who moved the report be adopted.*]

Mr. Campbell: I should like to ask if the committee has given full consideration to the practice of having four different size holes in the tie for the various sized spikes, and whether it would be satisfactory to use one size of bored hole for two sizes of spikes, the idea being to make this as simple as possible and reduce the possibility of the improper delivery of ties to the track men, as regards the size of the holes and the size of the spikes.

Chairman Burton: The committee, after a study, is of the opinion that the four sizes are necessary for the best results.

[*The motion to adopt the report was carried* and the commmittee was excused with the thanks of the association.]

Little Rollo and His Pop

Chapter II.—Wherein the adage beginning "Out of the mouths of babes" is proved to be true

ROLLO was literally bubbling with excitement as he raced through the halls of the Palmer House yesterday. What with old friends to greet, new ones to meet, overseeing the registration, and getting in everyone's way, he was busier than the well-known paperhanger.

It was only with the greatest difficulty that Pop got him quieted down and into the meeting room. Rollo gazed about him, his bright little eyes sparkling with even more than their usual zest. Nothing escaped him, a fact of which his Pop is only too painfully conscious.

"Gee, Pop," he remarked, "these fellows look somewhat different this year, sort of puffed up about something, if you know what I mean."

"You're right, my lad," replied Pop, as he threw out

Rollo Giving His Little Brother the Low-Down

his chest, cleared his throat, and straightened his tie (a violent green one with heliotrope polka dots, that his wife gave him for Christmas and makes him wear). "I certainly can notice a conscious air of pride among my fellow engineers."

"And why is that?" inquired his proud progeny.

"Because, Rollo, the day before yesterday, the people of these United States inaugurated an engineer as President."

To everyone's astonishment, Rollo was quiet for nearly five minutes. Having thus established a world's record, he burst forth:

"Holy smoke, Pop, what's this, the Serbian army?"

There was indeed a large movement towards the platform, somewhat reminiscent of the old Fifth Ward Marching Club. Member after member filed up until the platform was not only filled, but overflowing.

"What the what?" inquired Rollo again.

His Pop surveyed the unusual scene and then, turning to his son, he said indulgently:

"No, that's not the Serbian army. That is not in fact, any army. That is merely "Dick" Knowles' Committee on Water Service and Sanitation."

"Are all engineers sanitary, Pop?"

"I doubt it, Rollo," replied Pop, "if some of the bunk houses I've slept in are any criterion."

"What does that gang do, Pop?"

"They work, my boy, they work. Not only have they finished this year's work, but they have already started on next year's program."

"Maybe you're right, Pop," interposed Rollo.

"Well, anyhow, Pop, I should think that after all the members of the association took a whiff or two of Mr. Knowles' stogies they would be sanitary, wouldn't they, huh, Pop?"

"Perhaps so, perhaps so," commented Pop, sagely.

"Hey, Pop, did you hear that they are going to change the name of Committee on Water Service and Sanitation?"

"No, why?"

"Yep, they're going to call it the League of Nations, because Mr. Knowles put every foreign member on it."

"Well, now that that's settled," interposed Pop, "let's be quiet for a few moments and listen to the discussion."

But quiet in Rollo's vicinity was as impossible as impure water on the Illinois Central.

"Hey, Pop," he yelled presently, "what's the difference between an engineer of the bureau of valuation and a valuation engineer?"

Pop considered a moment and then said: "Mr. J. L. Campbell, our past president, answered your question exactly when he wrote: 'The engineers of the bureau of valuation say that 2 and 2 make 3, less depreciation, while the railway valuation engineers say that 2 and 2 make 5, plus appreciation."

Rollo considered this solemnly; and, let it be said here, it is worthy of solemn consideration.

Rollo listened to the discussion for perhaps 18 seconds and then he said:

"Why, there's Mr. Blaess of the Illinois Central. Hey, Mr. Blaess!"

There was much turning of chairs at this interruption and President Faucette looked at Rollo's Pop in not unwarranted disapproval.

"Stop it, Rollo," Pop said, "What's the idea of stopping the proceedings?"

"Well, Pop, I wanted to ask Mr. Blaess if he were going to make a speech. Did you ever hear Mr. Blaess make a speech, Pop?"

"Not exactly, Rollo. I went to the Western Society of Engineers a couple of months ago to hear Mr. Blaess speak on flood prevention, but he had been called to Washington. Then I went to hear him speak at the Wood Preservers' Convention."

"Did he speak then?"

"No, Rollo, he had been called to Washington again."

"Say, Pop, do you suppose—"

"Never mind, never mind," commented Pop, and that was that.

A.R.E.A. Registration

A TOTAL of 710 members and 237 guests, or a grand total of 947 persons, registered at the A. R. E. A. convention yesterday. This compares with a registration of 644 members and 189 guests, or a total of 833 persons, on the first day last year and a registration of 547 members and 221 guests, or 768 persons, on the first day in 1927. The names of those registering yesterday follow:

Members

A

Ackerman, F. J., sig. engr., K. C. T., Kansas City, Mo.
Adamson, R. L., chief engr. L. A. & S. L., Los Angeles, Cal.
Adsit, C. R., asst. div. engr., B. & O., Garrett, Ind.
Ainslie, A. F., supvr. bridges and bldg., N. P., Glendive, Mont.
Alexander, F. W., engr. maint. of way, Can. Pac., Winnipeg, Man., Can.
Amory, G. G., asst. engr., C. & W. I., Chicago.
Anderson, B. T., asst. to vice-pres., Union Switch & Signal Co., Swissvale, Pa.
Anthony, W. R., water treat. plant supvr., M.-K.-T., Parsons, Kans.
Armstrong, C. E., asst. engr., N. & W., Portsmouth, O.
Armstrong, J. E., asst. engr., Can. Pac., Montreal, Can.
Armstrong, S. E., engr. of stand., N. Y. C., New York City.
Arter, J. B., asst. engr., B. & O., Akron, O.
Ashton, F. G., asst. to vice-pres., Foundation Company, New York City.
Astrue, C. J., chf. draft., S. P., San Francisco, Cal.
Atwood, W. G., cons. engr., New York City.
Austill, H., bridge engr., M. & O., St. Louis, Mo.
Avery, David L., chf. draftsman maint. of way, C. & O., South Richmond, Va.

B

Babbitt, J. H., asst. div. engr., B. & O., Newark, O.
Backes, E. W., asst. engr., B. & M., Boston, Mass.
Backus, M. M., asst. engr. maint. of way, I. C., Chicago.
Baker, Clarence, asst. engr., M. P., Houston, Tex.
Baker, J. B., chf. engr. maint. of way, Penna., Pittsburgh, Pa.
Baker, P. S., engr. bridges and bldgs., Reading Co., Philadelphia, Pa.
Bakhshi, S. R., asst. engr., C. B. & Q., Chicago.
Baldridge, C. W., asst. engr., A. T. & S. F., Chicago.
Baldwin, R. A. engr. con., Can. Nat., Toronto, Ont., Can.
Balkwill, Stephen, pres., The Balkwill Manganese Crossing Co., Cleveland, O.
Ballard, E. E., engr., St. Louis Frog & Switch Co., St. Louis, Mo.
Bardwell, C. M., asst. water engr., M.-K.-T., Waco, Tex.
Bardwell, R. C., supt. water sup., C. & O., Richmond, Va.
Barr, W. M., con. chem., U. P., Omaha, Neb.
Barrett, W. A., asst. engr., B. & O., Pittsburgh, Pa.
Barricklow, D. B., Barricklow Construction Co., Columbus, O.
Barry, H. B., prin. asst. engr., St. L.-S. F., St. Louis, Mo.
Bartlett, A. L., div. engr., N. Y. N. H. & H., New Haven, Conn.
Bartlett, Calvin, real est. agt., Wabash, St. Louis, Mo.
Batchelder, F. L., chf. engr., C. R., Houghton, Mich.
Bates, F. E., bridge engr., M. P., St. Louis, Mo.
Baxter, J. J., asst. chf. engr., Wabash, St. Louis, Mo.
Bayer, E. J., engr. maint. of way, P. & E., Indianapolis, Ind.
Beale, F. D., supt., C. & O., Richmond, Va.
Bean, P. L., div. engr., S. A. L., Atlanta, Ga.
Beard, M. H., asst. div. engr., B. & O., Akron, O.
Belcher, R. S., man. treat. plants, A. T. & S. F., Topeka, Kans.
Bell, G. A. W., Jr., maint. inspec., B. & O., Washington, D. C.
Bennett, Edgar, engr. main. of way, S. R., Knoxville, Tenn.
Bennett, W. R., asst. chf. engr., Wabash, St. Louis, Mo.
Bernhardt, J. E., bridge engr., C. & E. I., Chicago.
Berry, W. A., asst. engr., M. P., San Antonio, Tex.
Beveridge, C. E., engr. main. of way and struc., Utah, Helper, Utah.
Bishop, C. E., asst. engr., M. P., Poplar Bluff, Mo.
Black, L. H., roadmaster, D. L. & W., Elmira, N. Y.
Black, M. P., asst. engr., I. C., Chicago.
Blackie, G. F., asst. chief engr., N. C. & St. L., Nashville, Tenn.
Blaess, A. F., chf. engr., I. C., Chicago.
Blair, T. A., div. engr., A. T. & S. F., Slaton, Tex.
Blake, Harry D., grade cross. engr., Wisconsin Highway Commission, Madison, Wis.
Blum, Bernard, chf. eng., N. P., St. Paul, Minn.
Boardman, Francis, asst. term. mgr., G. C. T., New York.
Bober, H. F., bridge inspec., C. R. I. & P., Chicago.
Boettcher, L. R., asst. engr., C. M. St. P. & P., Milwaukee, Wis.
Bogardus, H. J., div. engr., P. M., Saginaw, Mich.
Bohnstengel, Walter, asst. engr. tests, A. T. & S. F., Topeka, Kans.
Bolin, W. C., office engr., B. & O.-C. T., Chicago.
Bond, F. L. C., gen. supt., Central Region, Can. Nat., Montreal, Can.
Bond, L. H., engr. maint. of way, I. C., Chicago.
Boots, E. W., engr. maint. of way, P. & L. E., Pittsburgh, Pa.
Botts, A. E., div. engr., C. & O., Huntington, W. Va.
Bousfield, Alfred, chf. engr., E. & T. Fairbanks Co., St. Johnsbury, Vt.
Boyce, W. S., asst. to pres., Railroad Supply Co., Chicago.
Boyd, G. E., assoc. editor, Railway Age, Chicago.
Boyer G. A., div. engr., S. P., Houston, Tex.
Braden, E. V., engr., P. C. & Y., Pittsburgh, Pa.
Bradley, A. C., engr., maint. of way, C. R. I. & P., Des Moines, Ia.
Brady, S. W., div. engr., G. C. & S. F., Beaumont, Tex.
Brameld, W. H., asst. to chief engr. m. of w., Erie, New York City.
Breed, C. B., prof. ry. engr., Massachusetts Institute of Technology, Cambridge, Mass.
Breed, C. W., engr. of standards, C. B. & Q., Chicago.
Brink, H. E., gen. asst. engr., N. Y. N. H. & H., New Haven, Conn.
Bronson, C. B., asst. insp. engr., N. Y. C., New York City.
Brooke, G. D., gen. mgr., C. & O., Richmond, Va.
Brooke, Richard, asst. engr. maint. of way, C. & O., Richmond, Va.
Brown, E. T., instrumentman, M. P., St. Louis, Mo.
Brown, H. F., dist. engr., N. P., St. Paul, Minn.
Brown, H. W., div. engr., Penna., Toledo, O.
Brown, J. M., asst. to vice-pres., C. R. I. & P., Chicago.
Brown, Roy A., instrumentman, C. R. I. & P., Rock Island, Ill.
Brown, W. G., engr. maint. of way, F. E. C., St. Augustine, Fla.
Brumley, D. J. (past-pres.), chf. engr., C. T. Improv., I. C., Chicago.
Brumley, D. J., chf. engr., I. C., Chicago.
Bryant, H. M., water serv. inspr., M. P., St. Louis, Mo.
Bucher, C. V., div. engr., N. Y. C., Charleston, W. Va.
Bucholtz, Carl, genl. mgr., Erie, Youngstown, O.
Buckley, V. B., Instrumentman, M. P., Little Rock, Ark.
Buehler, Walter, con. engr., The Barrett Co., New York City.
Bullard, R. R. L., asst. engr., C. & O., Richmond, Va.
Bunney, W. H., vice-pres. & gen. mgr., M. W. S., Belfry, Chicago.
Burrell, C. F., engr., maint. of way, K. & I. T., Louisville, Ky.
Burroughs, Russell, div. engr., B. & M., Concord, N. H.
Burton, W. J., asst. to chief engr., M. P., St. Louis, Mo.
Butler, E. S., asst. to chmn., M-K-T., New York City.
Butler, R. E., engr. maint. of way, N. & S. S., Cleveland, O.
Butterworth, A. S., res. engr., M. P., St. Louis, Mo.

C

Cahill, R. E., asst. div. engr., M. P., Atchison, Kans.
Campbell, C. W., dist. engr., M.-K.-T., Wichita Falls, Tex.
Campbell, J. L., (past pres.) chf. engr., S. P., San Francisco, Calif.
Canty, J. P., asst. to engr. maint. of way, B. & M., East Cambridge, Mass.
Carpenter, R. H., draftsman, M. P., St. Louis, Mo.
Carrick, O. W., Electro-Chemical Engineering Corp., Chicago.
Carter, H. K., asst. div. engr., C. C. C. & St. L., Mattoon, Ill.
Casey, R. W., asst. chf. draftsman, C. & N., Chicago.
Cassil, H. A., chf. engr., P. M., Detroit, Mich.
Caudle, R. E., asst. engr. structures, M. P., Houston, Tex.
Chapman, E. E., engr. tests, A. T. & S. F., Topeka, Kans.
Chase, J. A., bridge engr., B. & A., Newtonville, Mass.
Chase, R. E., instrumentman, M. P., Eureka, Kan.
Chevalier, C. R., asst. engr., M. P., Washington, Mo.
Chinn, Armstrong, engr. maint. of way, C. B. & Q., Lincoln, Nebr.
Chipman, Paul, val. engr., P. M., Detroit, Mich.
Chorley, R. W., mech. inspr., Penna., Indianapolis, Ind.
Christian, W. A., engr. track elev., C. & W. I., Chicago.
Christiansen, Eli, asst. engr. of bldgs., C. R. I. & P., Chicago.

Christianson, H. B., div. engr., C. M. St. P. & P., Sioux City, Ia.
Christoph, E. E., div. superv. of motor cars, I. C., Carbondale, Ill.
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Clark, W. A., asst. to gen. mgr. and chf. engr., D. & I. R., Duluth, Minn.
Clarke, H. R., gen. insptr. perm. way & structures, C. B. & Q., Chicago.
Clarke, H. S., engr. maint. of way, D. & H., Albany, N. Y.
Coburn, Maurice, asst. to engr. main. of way, Penna., Chicago.
Cochran, J. A., maint. insp., B. & O., Baltimore, Md.
Cochrane, R. L., chf. clk. to chf. engr., A. T. & S. F., Chicago
Colladay, W. E., asst. engr., I. C., Chicago.
Colvin, C. S., div. engr., G. C. L., DeQuincy, La.
Condon, F. O., cons. engr., Century Wood Preserving Co., Pittsburgh, Pa.
Congdon, C. O., vice-pres., Railroad Water & Coal Handling Co., Chicago.
Connell, C. H. N., dist. engr., C. N., North Bay, Ont., Can.
Constance, Walter, supvr. of reclam., C. & O., Barboursville, W. Va.
Converse, D. W., asst. engr., A. C. & Y., Akron, O.
Cook, C. C., maint. engr., B. & O., Baltimore, Md.
Cook, O. U., inspec. engr., Tennessee Coal, Iron & Railroad Co., Birmingham, Ala.
Cooke, C. C., secy., Fritz-Rumer-Cooke Company, Columbus, O.
Coon, C. J., asst. engr., N. Y. C., New York City.
Coughlan, R. E., supvr. of water sup., C. & N. W., Chicago.
Courtenay, W. H., chf. engr., L. & N., Louisville, Ky.
Craft, E. A., engr. maint. of way, S. P., Houston, Tex.
Craine, Arthur, American Hoist & Derrick Co., St. Louis, Mo.
Crocker H. B., chem. engr., Dearborn Chemical Co., Chicago.
Crosley, A. P., div. engr., Reading Co., Harrisburg, Pa.
Cross, Hardy, prof. of structural engineering, University of Ill., Urbana, Ill.
Crowell, H. C., asst. to chf. engr., Penna., Philadelphia, Pa.
Crugar, E. L., engr. of con., I. C., Chicago.
Crump, J. T., asst. div. engr., C. & O., Richmond, Va.
Cudworth, W. O., asst. engr. maint. of way, C. P., Montreal, Can.
Curtiss, G. W., div. engr., N. Y. N. H. & H., Danbury, Conn.
Curtiss, W. L., engr. water serv., N. Y. C., New York City.
Cushing, W. C., (past pres.), engr. of standards, Penna., Philadelphia, Pa.
Cutler, A. S., prof. of railroad engrng., University of Minnesota, Minneapolis, Minn.

D

Daley, C. A., Air Reduction Sales Co., New York City.
pany, New York City.
Dare, C. E., engr. maint. of way, R. F. & P., Alexandria, Va.
Darrow, F. T., asst. chf. engr., C. B. & Q., Lincoln, Neb.
Dart, C. R., con. engr., Wilmette, Ill.
Davidson, J. H., water engr., M.-K.-T., Parsons, Kans.
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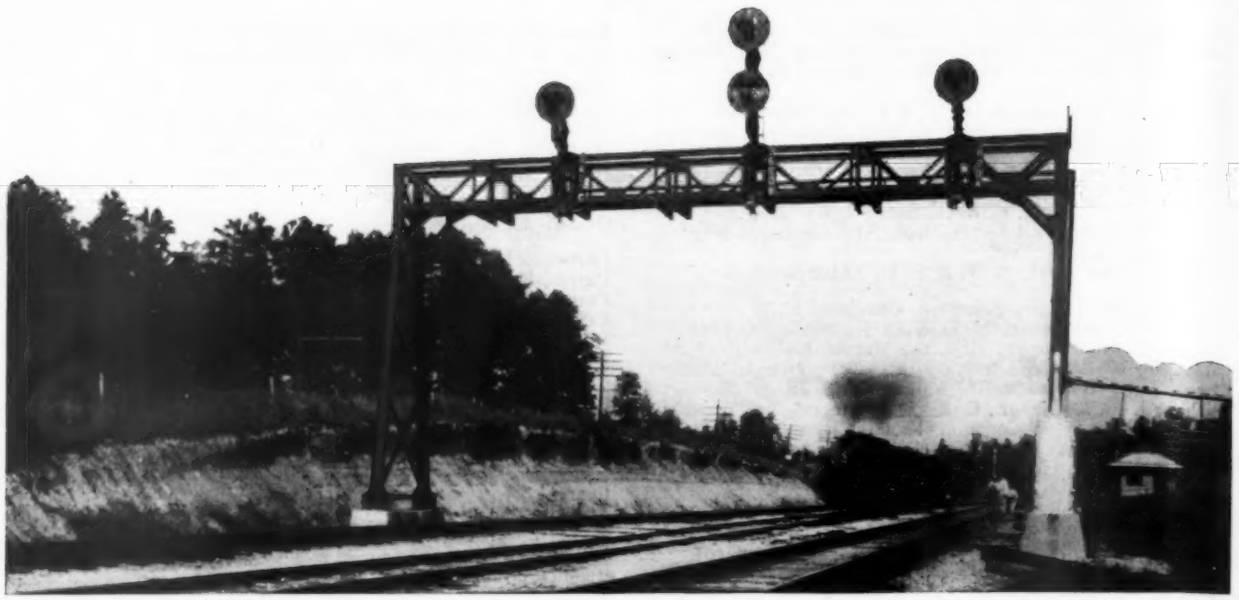

Southbound Passenger Train on the Missouri Pacific at Bryant, Ark.

Signal Section Convention Ends

Prompt handling of committee reports expedites work— New officers elected

THANKS to the expeditious handling of the first day's program of the convention of the Signal Section, A. R. A., at the Stevens Hotel on Monday, the second and closing day's session opened at 10 o'clock yesterday morning with only four reports to be presented. Carl F. Stoltz, signal engineer of the Cleveland, Cincinnati, Chicago & St. Louis, presided as chairman.

Among the information presented yesterday, perhaps that of most general interest was the report of the Special Committee on Highway Crossing Protection, of which A. H. Rudd, chief signal engineer, Pennsylvania, is chairman. On account of the increasing number of accidents at crossings, every effort is being made to standardize automatic crossing signals and to educate the public to the meaning of the indication when a train is approaching. Several roads are assigning certain officers to give illustrated lectures in schools. Other roads have exhibits of signals in stations and public buildings with signs and literature explaining the operation and indications of the signals.

Several new features are being developed to increase the effectiveness of crossing signals. The state of Connecticut has requested the roads to install flashing light signals facing in each direction along the highway on each side of the railroad. One purpose of these extra signals is to afford an indication, in case the signal at the right is hidden by a parked car. In Canada, where wigwags are used, a separate signal is required on each side of the track on all double track lines.

A signal incorporating a Fresnel type lens, to give an indication through 180 or 360 deg. in a horizontal plane, has been developed on the New York, New Haven & Hartford. This signal will indicate, effectively to the automobile driver while he is approaching or passing the signal, but a unique blinder prevents the red light from being seen by an engineman of an approaching train.

The committee definitely recommended that the traffic type "stop and go" signal used at street intersections, should not be employed as an automatically-controlled signal for indicating the approach of trains.

Soon after the meeting opened, the chairman introduced L. F. Shedd, superintendent of safety of the Chicago, Rock Island & Pacific, who spoke informally on the general subject of the safety-first movement on the railroads. An abstract of his remarks follows:

The safety movement in America was started by the railroads. Ralph C. Richards, formerly claim agent of the Chicago & North Western, was the father of the movement on the railroads. Other roads followed quickly, and because of their activity civic bodies and others became interested. The safety movement today is one of the most important phases of railroading. Of course, we must operate our railroads, but always as safely as possible. Safety pays in human happiness, and in dollars and cents, and we cannot separate the humanitarian aspect from the financial.

Safety men have long realized that education is the greatest medium through which we can benefit those whom we are trying to reach. But it is necessary to have something that will go a little further than education; call it legislation, discipline, moral suasion, or what you will. We must have some way of affecting the fellow who is not readily impressed, because if left to himself he is a menace to the "crowd."

Safety is an individual proposition, for we will never be successful in talking safety to the masses.

In 1927, we attained the remarkable record of only 10 passengers killed in passenger-train accidents on the railroads of the United States. Only two passengers have lost their lives in passenger train accidents on the Rock Island in the last nine years, in spite of the fact that we have carried more than eight million passengers in that period. We operated one of our large terminals (where we employ 30 switch engines 24 hours a day) for two consecutive years with only one switchman killed and this man fell off the top of a car. Another yard, a little larger, was operated during the same two years without having a switchman killed, and in these two yards we handled about 6¼ million cars.

Report on Highway Crossing Protection

Federal and state activities affecting signals explained—
No green light to be shown for highway

A. H. Rudd
Chairman

RECENT developments in the field of highway crossing protection, particularly as to the feasibility of automatically controlled crossing gates, the trend of federal and state activities relative to the crossing protection problem, and the use of traffic signals at railway grade crossings, were touched upon in this committee's report which is given here with certain portions abstracted.

The subject of traffic signals was discussed at some length at the A. R. E. A. meeting in March, 1928, at which time the opinion was unanimously against the display of a green light on a highway crossing signal.

The committee supplemented its previous report by referring to a meeting of the Committee on Street Signs, Signals and Markings of the American Engineering Council, held in New York on October 2, 1928, at which time that committee (having approved as standard the A. R. A. highway crossing signal) adopted the recommendation which is given in this report.

Progress Report on the Development of Highway Crossing Protection

The chairman received communications from a number of inventors, describing their devices, many of which were impracticable of application. Several ingenious methods have been devised for reducing to a minimum the damage which might be caused by automatic gates descending upon automobiles or pedestrians; also the damage to both the vehicle and the gates which have begun to descend, or which have been lowered across the highway. The committee is watching the various developments and has examined several schemes, some of which provide a warning bell, that operates for a few seconds before the gate begins to drop.

Trial installations have been made on the Illinois Central at Council Bluffs, Iowa, and on the Chicago, North Shore & Milwaukee, at Niles Center, Ill. In the latter installation the gates are located far enough from the track so that, if they are struck by a vehicle, they can swing 90 deg. horizontally without striking the train, thereby saving the gate. Another trial installation has been made on the Terre Haute, Indianapolis & Eastern Traction Company's line north of Indianapolis, Ind. The Chicago, North Shore & Milwaukee is preparing to install automatic crossing gates at 19 locations. The committee did not have sufficient data to warrant making a definite recommendation. One type has been approved by the Wisconsin state commission.

Federal and State Activities—Protection of Railroad and Highway Crossings

The Nebraska state legislature passed a bill in the latter part of 1927, a section of which reads as follows:

"Power is conferred upon the Department of Public Works to devise and supervise the manufacture and erection of stop signs or warning signs at railroad grade crossings where the same intersect state highways and where, in the judgment of the Department of Public Works, it is deemed advisable in the interest of public safety. Power is conferred upon the boards of county commissioners or supervisors to devise and supervise the manufacture and erection of stop signs or warning signs at the intersection of county highways and railroad grade crossings where, in the opinion of such boards, public safety demands the same. All expense of stop signs or warning signs, both as to cost of purchase and placing same, shall be borne exclusively by the railroad company where such markers are placed. All motor vehicles approaching a railroad grade crossing where such stop sign is erected shall come to a complete stop at least 50 ft. back of the center of the rails of such intersecting railroad. At all railroad crossings except those before described in this section, any driver of any motor vehicle shall slow down to 12 m. p. h. at least 50 ft. from the center between the rails and then shall look carefully both ways to assure himself that there is no danger from approaching trains before crossing said railroad."

Since the passage of this bill, the state engineer of Nebraska has requested the Union Pacific to select certain railroad crossings where the view is obscured and on which crossings the stop signs provided in the bill are to be erected. Fourteen such crossings were selected by a committee composed of the safety department of the railroad and the Department of Public Works. All other crossings are to be equipped with a sign reading "Speed 12 miles per hour, State Law," to be attached to the A. R. A. approach warning sign. The state engineer of Nebraska advised in September that luminous or night markers should be provided at all railroad grade crossings, regardless of whether a stop sign or speed limit sign is provided. The committee is advised that the stop sign will be of the design recommended by the American Association of State Highway Officials.

The committee called attention to the fact that the designation of certain dangerous grade crossings, at which all vehicles must stop is in accordance with the Uniform Vehicle Code. The provision of a speed limit of 12 m.p.h. at the other grade crossings is not in strict conformity with the code, which omits all positive limits, requiring operators at all times to hold to a speed that is safe for the conditions prevailing, but cannot be considered greatly at variance from it.

A. H. McKeen (U. P.), cites, as an indication of the mental attitude of the local bodies, the case of a local ordinance in a small town in Nebraska, requiring all trains to slow down to 12 m.p.h. when passing through the town limits; as only local trains stopped at this point, the ordinance worked a hardship with respect to train operation. The railroad was successful in having this ordinance rescinded only by complying with the

demands of the local authorities for the erection of flashing-light signals on each side of the track, with illuminated stop signs in red letters.

The Interstate Commerce Commission has never taken jurisdiction over crossings of railroads and highways, although it frequently reports on fatal accidents at such intersections. However, the Bureau of Highways is deeply interested in standardization. As far as we are advised, there are no state laws requiring any particular type of protective signals, although many require crossing signs, but in most of the states which have public service commissions, these commissioners have authority to specify the type of protection to be afforded, although in West Virginia the State Road Commission is given jurisdiction. There is no public service commission in the State of Delaware.

Results of Questionnaire

On March 29, 1928, the committee circularized 24 signal engineers in the United States and Canada, and the following is a summary of the replies received:

(Q.) *Does law provide for any type of automatic signal protection at a crossing of a highway with a railroad, and, if so, what?*

(A.) With the exception of Arizona, Illinois, Kansas, Missouri, New Mexico, Oklahoma and South Dakota, from which no replies were received, none of the state laws provide for any type of automatic protection, although many of them confer authority upon the public utilities commission to provide it—Indiana being the only one which specifically authorizes the commission to require a flagman, gong or bell.

(Q.) *Has the commission adopted any type as standard?*

(A.) No reply in regard to New Mexico or Oklahoma. None of the other states have established an exclusive standard except California which requires a two-position wig-wag with red disc, red light and bell, although permitting the use of the three-position wig-wag; Illinois permits either wig-wags or alternately flashing red lights; Minnesota, wig-wags until 1927, Griswold signal for all new signals; New Jersey, wig-wags or alternately flashing red lights; New York, alternately flashing red lights; North Dakota, wig-wag; Pennsylvania, alternately flashing red lights; Rhode Island, alternately flashing red lights; Canada, bell only approved by general order.

(Q.) *If no standard is established, has the commission indicated any preference for any type?*

(A.) No replies regarding Arizona, Kansas, New Mexico or Oklahoma. As far as the other states are concerned, none have indicated any preference except the following: Connecticut, which prefers alternately flashing red lights where they afford sufficient protection; Iowa, alternately flashing red lights; Maine and New Hampshire, until recently favored audible-visible wig-wags, permission given to install flashing lights; Maryland, alternately flashing red lights; Ohio, either wig-wags or flashing lights; Rhode Island, under certain circumstances, favors alternately flashing red lights; South Dakota, wig-wags and Griswold signal; Vermont, wig-wags and alternately flashing red lights; Virginia, wig-wags, flashing lights and traffic light types approved; Wisconsin, wig-wags on account of uniformity.

(Q.) *If more than one type is permitted, has the commission made any ruling as to what types are permissible or will be approved?*

(A.) No reply from Arizona, Kansas, New Mexico or Oklahoma. None of the other states have made a ruling except: California, which permits either the two or three-position wig-wag; Indiana, wig-wags in country districts, and flashing lights in cities and towns; Iowa, wig-wags and flashing lights; Massachusetts, standard flashing lights, but no single standard; Michigan, wig-wags satisfactory; Minnesota, flashing lights in some cases; New Hampshire, flashing lights; Rhode Island, might permit more than one type, but favors alternately flashing red lights; Canada, wig-wags and bells, at many locations; wig-wags approved without bells; no bells approved recently without wig-wag; flashing lights ordered for trial.

(Q.) *Has the commission indicated any desire to have automatic highway crossing gates provided?*

(A.) None of the state commissions have so indicated. The Board of Railway Commissioners for Canada ordered the installation of one for test at a crossing equipped with wig-wags.

(Q.) *Has the commission authority to specify the standard crossing signal?*

(A.) The commission has such authority in the following states: California, Colorado, Connecticut, Idaho, Illinois, Iowa, Maine, Massachusetts, Michigan, Minnesota, Nebraska, Nevada, New Hampshire, New York, North Carolina, North Dakota, Ohio, Pennsylvania, Rhode Island, Texas, Utah, Vermont, Wisconsin and Wyoming.

(Q.) *Is there any law or ruling which provides for a division of cost of crossing protection between the railroad and other interested parties like the highway department?*

(A.) There is no such law or ruling except in the following states: California, where at existing crossings or those created by the construction of new railroad lines, the railroad bears the entire cost, but at crossings created by new streets, the city or highway commission bears the cost of installation, and the railroad the cost of maintenance and operation. In Michigan, the law provides for the paying of a share of the cost by the township or city. In Minnesota, the highway department has voluntarily paid part of the expense. In Pennsylvania, there is an agreement with the highway department approved by the commission. In Canada, 40 per cent of the initial cost of protection or separation up to a maximum of $25,000 is paid out of the grade crossing fund by the government. The board has the authority to cause the local authorities to contribute toward the cost of protection.

(Q.) *Are there any cases where both audible and visible signals are required and generally what appears to be the preference of the commission as between visual signals and bells or other alarms?*

(A.) The commissions of the following states have expressed no preference: Alabama, Arizona, Arkansas, Colorado, Idaho, Kansas, Kentucky, Maryland, Massachusetts, Montana, Nebraska, New Jersey, New Mexico, North Dakota, Oklahoma, Oregon, Tennessee, Texas, Utah, Washington, Wisconsin, Wyoming and West Virginia.

The commissions of the following states prefer visible and audible signals: California, Illinois, Indiana, Iowa, Nevada, North Carolina, Ohio (where pedestrian travel is frequent), Rhode Island, and Virginia (where pedestrian travel is heavy). Canada has ordered wig-wags with bell and illuminated danger sign in the West.

The commissions of the following states prefer visible signals only: Connecticut, Maine, New Hampshire, New York, Pennsylvania and Vermont.

(Q.) *What is the general attitude of the local authorities?*

(A.) In several of the states the attitude of the local authorities has not been indicated. In the following states, the local authorities have indicated a preference for visible signals: California, Illinois, Indiana, Iowa, Massachusetts, Nevada, New Hampshire, New Jersey, New York, Tennessee, Vermont and West Virginia, and in the Dominion of Canada. In the following states, the local authorities have indicated a preference for audible and visible signals: Louisiana, Maryland and Texas.

In some cities in the following states, the local authorities have required the removal of bells on account of the noise: Minnesota, Montana, North Dakota and Washington. In North Carolina, the country authorities generally favor bells; in the cities, the authorities prefer traffic signals.

Use of Traffic Signals at Grade Crossings

Engineering Council Recommendation

The report of the Committee of the American Engineering Council on Street Traffic Signs, Signals

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and Markings, 1929, provides: Recommendation 67—Train Approach Signals, as follows:

"Two well recognized types of signals are now used to indicate the approach of a train at a grade crossing. They are equally visible, and either may be used, namely:

"(a) A signal that swings a target and a red light across the highway.

"(b) A signal that flashes alternately two red lights, which are in a horizontal line 30 in. apart.

"Regular street traffic control signals are sometimes used at railroad crossings particularly within city limits. Their use is enforceable under city ordinances, but they should be used instead of the foregoing standard signal only if operated manually, or by combined automatic and manual control under supervision. If not operated continuously the standard train approach signal should be used when the traffic control signal is not in operation."

Municipal Traffic Ordinances and Regulations of the National Conference on Street and Highway Safety

The model municipal traffic ordinances, prepared by the Committee on Municipal Traffic Ordinances and Regulations of the National Conference on Street and Highway Safety, provides as follows:

Traffic Control Signal Legend

"Whenever traffic at an intersection is alternately directed to proceed and to stop by the use of signals exhibiting colored lights or the words 'Go,' 'Caution,' (or 'Wait') and 'Stop,' said lights and terms shall indicate as follows:

"(a) Green or 'Go'—Traffic facing the signal may proceed, except that vehicular traffic shall yield the right-of-way to pedestrians and vehicles lawfully within a crosswalk or the intersection at the time such signal was exhibited.

"(b) Yellow or 'Caution' (or 'Wait') when shown following the green or 'Go'—Traffic facing the signal shall stop before entering the intersection unless so close to the intersection that a stop cannot be made in safety.

"(c) Red or 'Stop'—Traffic facing the signal shall stop before entering the intersection and remain standing until green or 'Go' is shown alone."

It will be noted that, under this section, a steady burning green light gives pedestrians absolute right-of-way over all vehicles.

Grade Crossing Signals

"The uniform vehicle code of the National Conference on Street and Highway Safety, which has been adopted by 14 states and is about to be adopted by many others, provides that:

"Whenever any person driving a vehicle or street car approaches a highway and steam or interurban railway grade crossing and a clearly visible and positive signal gives warning of the immediate approach of a railway train or car, it shall be unlawful for the driver of the vehicle or street car to fail to bring the vehicle to a complete stop before traversing such grade crossing."

Bound in with the model municipal traffic ordinance is a voluminous statement on the recommended scope of the ordinance. It states that, "The model ordinance has been prepared as supplemental to and in conformity with the uniform vehicle code."

This entire ordinance and the notes may be obtained from C. W. Stark, secretary of the Committee on Municipal Traffic Ordinances and Regulations of the National Conference on Street and Highway Safety, Department of Commerce, Washington, D. C.

The aforementioned ordinance states:

"It is recommended, therefore, that the city council or other local authority, when determining the character of official traffic signs and signals as provided in the ordinance, give careful consideration to and, if possible, adopt the standard system of signs recently recommended by the American Engineering Council, which was prepared by a committee appointed by that body at the request of the National Conference on Street and Highway Safety. This standard system is in harmony with the standards for rural highways adopted jointly by the American Association of State Highway Officials and the U. S. Bureau of Public Roads. The committee's report may be obtained from the American Engineering Council, 26 Jackson Place, N. W., Washington, D. C."

This report is now issued and the following included in the report, will doubtless be of interest:

"The specifications for railroad crossing and railroad crossing approach signs are taken from the code adopted by the American Railway Association. It is recommended that they be used as standards where they do not conflict with state laws.

Rule 66—Train Approach Signals

"There are two well-recognized types of signals now in use for indicating the approach of a train at a grade crossing. The visibility of each is substantially the same, and either one may be used. (a) A signal which swings a target and a red light across the highway; (b) A signal which alternately flashes two red lights (fixed in a horizontal line 30 in. apart).

Rule 79—Railroad Crossing Gates

"1. Gates protecting railroad grade crossings shall be marked with alternate stripes of black and white, 9 in. wide, placed at an angle of 30 deg. with the horizontal when the gates are in the lowered position across the highway; 2. Both sides of the gates shall be painted alike. The foregoing are the standards adopted by the American Railway Association."

Conclusions

The context of this report shows that the foregoing note applies only to railway-highway crossings. "The Committee of the American Engineering Council is, therefore attempting to establish the principle, as indicated above, that a steady burning red light at crossings and intersections indicates stop and stay; a flashing light gives warning, and, when red, requires a stop, after which the vehicle may proceed if the way is clear. It also advocates the general principle that all warning lights shall be yellow."

From the foregoing, it will be seen that the principle is recognized, first, that there is a distinction between these "Stop and Stay" signals and a signal giving warning of ends of streets or places where vehicles shall slow down, and second, a distinct difference between these stop and warning signals and signals indicating the approach of a train.

The signal recommended by the Signal Section and the American Railway Association has also been made standard by the American Railway Engineering Association, the American Association of State Highway Officials and the American Engineering Council. It has been accepted by the National Conference on Street and Highway Safety in its endorsement of the proposed standards of the American Engineering Council, and has been made the American standard by the American Standards Association.

This standard signal is distinctive and used for only one purpose. It is more arrestive to the eye than a steady burning light. A movement is well under way to instruct crossing watchmen on duty at night to swing their lamps horizontally across the highway if a train is approaching, and thereby further educate the public to the idea that the appearance of a swinging light indicates the approach of a train. It is proper that a steady burning red light should be used on lowered highway crossing gates because they indicate "Stop and Stay" until the gates are raised.

There are many conditions at crossings protected by automatic signals where it is perfectly allowable for vehicles to pass after stopping and ascertaining these conditions and where their remaining stopped until the signals change would seriously congest highway traffic, and a "Stop and Stay" signal might not only congest traffic, but cultivate a disregard for the signal.

A railroad has no authority to enforce the observance of this "Stop and Stay" indication, and should not provide it unless required by state law or by authorities having jurisdiction. Its duty ends when it indicates the approach of a train and the standard signal conforms to the principles enunciated by the Hoover conference (National Conference on Street and Highway Safety).

We are advised that it is surprising to find in the defense of personal injury lawsuits how many people there are who cannot distinguish colors, and, even if they can distinguish them, are confused in mistaking one for another. This difficulty is so apparent to the authorities of many municipalities that they have not only put up the colored light signals but have also put up semaphores, so that the traveler cannot escape responsibility by saying that he mistook one color for another. The A.R.A. highway crossing signal eliminates this danger.

A green light would be an invitation to cross the railroad track. This is its function in general highway traffic and at street intersections. The courts have placed upon the driver the responsibility of seeing that the way is clear. A green light is an invitation to cross; in fact, with the ordinary traffic signal, it is a command to proceed. Any exhibition of a green signal by the railroad is an invitation to cross, and such invitation places the responsibility on the railroad instead of on the driver.

A good many states require that the speed of a vehicle be reduced when approaching a steam railroad crossing, and, in some cases, require a stop. Experience has shown that, when

a green traffic light is shown, drivers of vehicles speed up in order to pass it before it changes, and if used at railroad crossings, it would doubtless have the same effect and encourage violation of the speed laws.

Therefore, it would appear that the only places where traffic signals might be used is where they are constantly policed by the municipal authorities, and in such cases, it is recommended that the signal be caused to display a red light by the approach of a train or action of the crossing watchman, and after the passage of the train, the apparatus to be restored so that the municipal authorities can give the proceed signal if they so desire.

Any general adoption of this traffic signal would destroy the uniformity which we are all attempting to obtain, and as before stated, tend to the disregard of the stop signal, which disregard is quite in evidence now, where traffic signals are not policed, or where it is seen that the officer is absent.

The expense of installing these signals would be less than the standard signal, but the cost of maintenance and operation with commercial current would be considerably more and with battery current would be prohibitive. The use of such a signal at some crossings and our standard signal at others, possibly at adjacent crossings or on the same highway where several railroads are crossed, one of which has power available and the next one not, would further tend to confusion.

For these reasons, the committee was of the opinion that the use of the ordinary traffic signal is inadvisable at highway grade crossings, although considerable pressure has been and will be brought to bear to adopt such a signal, especially within city limits.

The committee desired to place reference to the foregoing in the Signal Section Manual and therefore presented the following for acceptance for submission to letter ballot:

MUNICIPAL TRAFFIC ORDINANCES AND REGULATIONS

The recommended practice of the National Conference on Street and Highway Safety may be obtained from the Secretary, Committee on Municipal Traffic Ordinances and Regulations, National Conference on Street and Highway Safety, Department of Commerce, Washington, D. C.

Adopted as recommended practice by the A.R.A. Signal Section, at Chicago, Ill., March 5, 1929.

Action recommended: acceptance for submission to letter ballot.

Discussion

[The report was presented by Chairman A. H. Rudd (Penna.) who mentioned several corrections that should be made in the report as printed in the advance notice. T. S. Stevens (A. T. & S. F.), a member of the committee, also pointed out a few corrections relative to the states to be included in the lists accompanying certain answers in the report. These corrections have been made in the report as shown herewith. With reference to the use of traffic signals at grade crossings, Chairman Rudd said, "The committee felt very strongly that signals for indicating the approach of the train should be used only when they are policed or are under supervision." With reference to that part of the report relating to the recommendation of the American Engineering Council, Chairman Rudd said, "The committee presents the following for submission to letter ballot: 'Report of the Committee of the American Engineering Council on Street Traffic Signals,' dated March, 1929, which provides a recommendation for a train approach signal, is approved as recommended practice of the A. R. A. Signal Section. *I so move.*" *The motion was carried.*]

Mr. Rudd: One of the most important developments is the request by the state commission of Connecticut to display each crossing signal in both directions, up and down the highway; they want a driver to see both of them. At first thought that seems foolish, because a man seeing a flashlight signal might stop on the track. The more this subject has been studied, the more the committee feels it is worth serious consideration. Some of the Connecticut commissioners felt that it was a good thing, especially at multiple-track crossings. If, when a train goes by, a driver of a closed car sees the signal ahead of him on his left still flashing, the chances are he will not go ahead.

C. H. Morrison (N. Y., N. H. & H.): The chairman of the Board of the Public Service Commission of the State of Connecticut believed that it would be a good idea to have the railroad grade crossing signals indicate in both directions. The New Haven equipped two highways and the commission was much pleased. The state of Connecticut will not permit a highway crossing signal to be installed in the center of the highway. If an automobile approaches a crossing and stops at the signal, it frequently stops at a point where the driver cannot see the signal on his right. He waits for the train to go by and then starts ahead, with the result that if a train is approaching in the other direction on the other track he is liable to be injured. Often it is difficult to locate the highway crossing signal at the right of the highway so that it may be seen by automobile drivers. Having one signal on the right and the other on the left makes it easy to place the signal so that the highway traveler will at least see one of them. If an automobile is standing at the signal blocking the view of the signal on the right, a car approaching from the rear is liable to swing around to his left not noticing the crossing signal and go ahead on to the tracks. With the new arrangement, if he swings to the left of the car, he will see the other signal on the left and he might stop.

The Fresnal lens situation has been developed with a view of trying to give an indication which would be visible at any angle up to 180 or 360 deg. I have been working on this for over a year and now have a signal which I believe is satisfactory.

At a crossing where the main highway runs parallel to the railroad, and a branch of the main highway goes over the crossing, it was necessary to put up two of the ordinary type of crossing signals on the same mast. In addition to that, in order to comply with the commission's request to have the signal visible across the railroad, it was necessary to put up three on one bank. If we could have a crossing signal with a visibility range of 360 deg. only one would be necessary. The new signal will be a success at junctions, highways and a number of difficult conditions that the signal which gives only a straight beam will not take care of. It was found that by the use of the Fresnal lens, which gives only a streak of light, rather than a circle of light, it is possible to place a small obstruction in the signal itself, about an inch in width, that will actually block that light in any desired direction. Having that obstruction movable, it can be adjusted so that the light will be kept away from the locomotive engineman.

Chairman Rudd: This proposition of having the light on the far left side of the crossing is new, but it does appear to have a number of advantages. The American Railway Engineering Association in a committee report that will be presented Wednesday suggests that the signals be placed in the center of streets in cities and on the right-hand side of highways outside of cities. I think it is a mistake to put lights in the center of the highway. If there is no safety island the signal should be placed on the side of the street. With the arrangement Mr. Morrison describes, a signal can be located on the right where it belongs, and if cars are parked in front of it, the far signal will give the indication. On the Pennsylvania we use peep holes so that the enginemen can see whether or not the signals are operating.

G. E. Beck (N. Y. C.): Is the repeater signal on the left side of the road in multiple with the first signal on the right?

Chairman Rudd: When a train is coming, the signals

on both sides of the track flash. With our present lenses and roundels, double the equipment is provided. The signals are back to back, and have four lamps instead of two, all flashing at once. That means double the consumption of battery while they are flashing. The question is whether it is justified by the greater protection afforded.

Mr. Morrison: We are using an 18-watt lamp in the Fresnel lens. The test I made was on a bright day with the sun back of the signal and shining in my face, and the signal gave a good indication. This signal also eliminates the possibility of a bad indication with the sun at your back as you approach the signal.

E. G. Stradling (C. I. & L.): We had a flashing-light signal on the side of a street, which gave a poor indication because a delivery truck is usually parked directly in front of the signal. If it were made high enough to clear the truck, the visor of an approaching automobile would cut it off. A signal on the opposite side of the track would never be obstructed and, therefore, would solve that problem.

Chairman Rudd: If this proposition were made standard, it would mean two wig-wags, one on each side of the crossing to get the same effect, one on the left and one on the right.

Educating the public as to the meaning of the indication of crossing signals is important. Several of the roads are placing sample installations in railroad stations. They plan to keep them there for five or six months and then to move them to some other state. Signs explain what they mean and how they should be observed. Some of the other railroads are sending instructors to the schools with models. Talks are given to the children, and in some cases in the high schools, they have the children prepare compositions, marking them just as they would examination papers. These children will be driving cars before long, and moreover they take this information home to their parents. Sometimes they take the "folks" down to the crossing to show them how the signal works. That is the way in which to educate the people.

We have been trying to arrange to have a circular explaining what these signals mean, sent out with each driver's license. It can be done economically when there is one standard, either the wig-wag or flashing light. The trouble is, many railroads have a number of different signals which vary from the standard. Those should be eliminated and then we will all be in a position to issue the circulars.

C. H. Tillett (C. N.): Canada has a requirement, which I believe is very good, to the effect that at double-track crossings a wig-wag must be used on each side of the tracks. It means a little more expense, but I believe we can afford it if we are going to protect children and property.

Mr. Morrison: Sometime ago at the annual meeting of the New Haven County Automobile Club, I succeeded in getting a full size highway crossing signal installed in a ballroom and I found that the attendant members were much interested in the explanation of the operation of the signal. Our safety department has an arrangement whereby men go to the schools to explain to the pupils the meaning, not only of the highway crossing signals, but of the gates and watchmen.

Report of the Committee on Chemicals

Specifications on dry cell and pin-type porcelain insulators presented

I. S. Raymer
Chairman

A REVISED specification for cylindrical dry cells such as supplied for signal purposes, and a new specification for pin-type porcelain insulators, comprised the report of the Committee on Chemicals. One of the important sections of the dry cell specification provided for four types of tests, namely; a light intermittent test, a heavy intermittent test, a continuous discharge test, and what is known as a shelf test. Of these, the requirements of the light intermittent test provided for connecting three dry cells in series and discharging them intermittently through a 20-ohm resistance. The discharge time intervals specified were four minutes each, there being 10 of these periods per hour. The test must be continued for six days a week, and on the seventh day, every other discharge period should be omitted. This arrangement provided for 65 discharge periods per week. Continuing further, the specification stipulated that in order to be accepted, a dry cell must satisfy the provisions of the following section:

"(2) The following readings will be taken:

(a) Initial open circuit voltage of the battery.

(b) Initial closed circuit voltage of the battery.

(c) Closed circuit voltage at the end of a dischage, after 7 days and every 7 days thereafter until the voltage falls below 3.5 volts, following which the readings are to be taken daily.

"(3) The test will be considered completed when the working voltage of the battery has fallen below 2.8 volts. The service will be reported as the total days on test to this cut-off voltage and shall be not less than 160 days.

"(4) The test should be started so that the readings will be made on a day having 10 discharge periods and, if possible, the voltage reading should be taken at the end of the last discharge period for the day."

The specifications covering pin-type porcelain insulators provided for a number of tests to insure adequate insulation and mechanical strength. A porosity test, a mechanical test, a dry flashover test, a wet flashover test, a voltage test of corona formation, a puncture test and other routine manufacturing tests were included in the specifications. For the most part, these tests were highly technical and could only be carried out in an electrical engineering laboratory. Selected paragraphs which related particularly to those features of insulator design and construction of most interest to the railroad user follow:

(4) **Material and workmanship**—(a) Material and workmanship shall be first-class in every respect.

(b) Material shall be of the best commercial grade so as to provide a homogeneous body or mass, which shall

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R. D. Ashley, supvr. sig., I. C., Chicago.
G. L. Baggerman, sig. supvr., L. & N., Paris, Ky.
F. A. Beck, sig. inspr., Pennsylvania, Pittsburgh, Pa.
J. P. Coleman, sig. supvr., G. T., Battle Creek, Mich.
C. R. Happ, sig. supvr., B. R. & P., Punxsutawney, Pa.
I. K. Johnson, gen. sig. inspr., D. L. & W., Hoboken, N. J.
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A. B. Himes, first asst. sig. engr., B. & O., Baltimore, Md. *Vice-chairman*
H. L. Kilian, sig. supvr., N. Y. C., Toledo, Ohio.
H. C. Lorenzen, asst. sig. engr., P. M., Detroit, Mich.
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W. S. Storms, asst. sig. engr., Erie, New York.
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be clean white color, hard, tough, dense and uniform throughout.

(c) The parts shall be reasonably true to shape and free from sharp edges, projections, checks, flaws, cracks, chips, holes, laminations, metallic substances, or other irregularities or defects due to improper or imperfect mechanical treatment, faulty drying or firing, inconsistent with the best commercial manufacture.

(d) The surfaces of insulators shall be glazed except where specified on drawings. The glaze shall be smooth, bright, firmly adherent, thoroughly vitrified and free from bubbles, cracks, checks, grazing or undissolved particles and shall be continuous over the specified portion of the surface.

(e) In the compounding of the glaze, lead oxide or lead salts, injurious to the glaze, shall not be used and the mixture shall have as nearly as possible the same coefficient of expansion as the porcelain.

(f) The finished parts shall conform to dimensions and tolerances shown on drawings.

(g) A tolerance will be allowed of 3 per cent plus or minus, except as otherwise shown on detailed drawings.

The committee appended to the specification the following list of definitions in order to explain the meaning of certain terms used.

A pin insulator is a complete insulator, consisting of one insulating member or an assembly of such members without tie wires, clamps, thimbles, or other accessories, the whole being of such construction that when mounted on an insulator pin, with suitable fittings, it will afford insulation and mechanical support to a conductor.

A shell is a single insulating member without cement or other connecting devices.

Dry flashover voltage is the voltage at which the air surrounding a clean dry insulator shell breaks down between electrodes, with the formation of a sustained arc, the test being made as described under "dry flashover test."

Wet flashover voltage is the voltage at which the air surrounding a clean wet insulator or shell breaks down between electrodes, with the formation of a sustained arc, the test being made as described under "wet flashover test."

Puncture voltage is the voltage at which an insulator or shell is electrically punctured when subjected to a gradually increasing voltage, the test being made as described under "puncture test."

The combined mechanical and electrical strength of an insulator is the load in pounds at which the insulator fails either electrically or mechanically, voltage and mechanical stress being applied simultaneously as described under "combined mechanical and electrical strength test."

The rating of an insulator shall be its dry flashover and wet flashover voltages expressed in kilowatts. Under standard test conditions the average of the dry flashover voltages of six insulators shall be within 5 per cent and the average of the wet flashover voltage of six insulators shall be within 10 per cent of the corresponding rating voltages. These allowances are made to provide for variables which are difficult to control.

The action recommended by the committee was that both of the specifications be accepted for submission to letter ballot.

Discussion

[The report was presented by Chairman I. S. Raymer (P. & L. E.) who stated that the committee had prepared a revision of the Specification for Cylindrical Dry Cells, but in view of some suggested changes in the U. S. Bureau of Standards specification for dry cells it was thought best to withdraw this specification for further consideration. The specification for Pin-Type Porcelain Insulators was presented by H. L. Kilian (N. Y. C.), chairman of the subcommittee, as a progress report. Mr. Kilian stated that one criticism received had to do with the voltage range and the committee did not believe it was necessary to say anything about the voltage range as the tests would determine the rating of the insulator. Primarily, it covered insulators intended only for signal work, or for service up to and including 660 volts.]

T. S. Stevens (A. T. & S. F.): I would suggest that the title be "Porcelain Insulators," and that it deal with all insulators which are made of porcelain, such as strain insulators, pin insulators and all others made of porcelain. A specification is needed.

Mr. Kilian: The test for a pin-type insulator is much simpler than for the other. As far as the strain insulator is concerned, these tests would answer. However the two tests cannot be combined. The A. I. E. E. has separate specifications.

J. E. Saunders (D. L. & W.): Has the Electrical Section, A. R. A., a specification on this subject?

Mr. Kilian: It has nothing like this.

Mr. Saunders: Does the committee care to commit itself definitely as to wet process porcelain in view of modern developments?

Mr. Kilian: It seems that that is not necessary, because nothing but wet-process porcelain can meet this specification.

G. E. Beck (N. Y. C.): I wonder if the three per cent tolerance includes the thread? We have had trouble caused by warping during the process of drying, to the extent that the threaded portion of the insulator was not true to size. We have had trouble getting them down on the "cob." Could the tolerance be cut down where it refers to the threaded portion of the insulator?

Mr. Kilian: This tolerance is provided more for the height, width, diameter and circumference. Of course, parts shall be reasonably true to shape.

Mr. Stevens: Aside from the thread, what is the necessity for such a close tolerance?

Mr. Kilian: Three per cent really is not very close. It is just double the tolerance that was allowed for the dry-process insulators.

[Mr. Kilian next referred to the dry and wet flashover tests. He asked whether or not the tests as devised by the A. I. E. E. would take care of everything. Another question that arose had to do with the moisture of the air and suggestions respecting this condition have been received. Then he suggested that, "Each insulator should have an identifying mark under the glaze, the word or mark to identify the manufacturer and the year of manufacture.]

Mr. Kilian: We believe it is essential to have each insulator so marked that after it is installed, the year of manufacture will be plainly evident.

Mr. Saunders: I believe the Signal Section is ordinarily concerned with insulators much smaller in

dimension than those covered by the A. I. E. E. It is hard to have the manufacturer's designation clearly indicated on small insulators. The same argument would apply to the tolerance.

Mr. Kilian: If we were to limit the tolerance to 1/16 or 1/8 in. there would be a greater variation in the small insulator than in the larger one. Therefore, we held to the percentage basis. These specifications were submitted to the manufacturers and they have approved them. They are all using the A. I. E. E. tests and specifications anyway. The three per cent tolerance is agreeable to the manufacturers.

[Subcommittee Chairman Kilian then withdrew the insulator specification, it having first been proposed for acceptance and later submission to letter ballot. He desired the change in procedure because of the more recent developments in the field of insulator tests. The committee was then excused.]

Report on Signaling Instructions

Last section of definitions and two more chapters of book presented for final approval

A. Vallee
Chairman

THIS committee submitted a list of 56 definitions of technical terms used frequently in signaling practice. The list submitted with the report comprised those definitions beginning with "Q" and continuing through the remainder of the alphabet. These definitions were submitted for acceptance and letter ballot approval. When finally accepted, these definitions will be complete from "A" to "Z", the preceding definitions having already been accepted by the Signal Section.

This committee also submitted for approval, two chapters prepared for the book entitled "American Railway Signaling Principles and Practices." These two chapters were Chapter II—Symbols, Aspects and Indications, and Chapter XI—Alternating Current Track Circuits. The committee has previously prepared and issued other chapters of this book entitled, Chapter V—Batteries, Chapter VII—Direct Current Track Circuits, Chapter VIII—Transformers, and Chapter XXIII—Highway Crossing Protection. By presenting each chapter for consideration at the annual meetings, the committee has been able to secure the benefit of the seasoned experience of the entire membership of the Signal Section, before final publication of any chapter. The committee has been carrying on this work for several years as part of its assignment to prepare material for the education and training of signal department employees.

Discussion

[The report was presented by Chairman A. Vallee (D. & H.), who called attention to some minor changes which the committee wished to make in the definitions. The motion that *the definitions as revised be accepted to supersede subject-matter in the Manual was carried.* Chapter II—"Symbols, Aspects and Indications" of the book, "American Railway Signaling Principles and Practices," was then presented for consideration.]

W. M. Post (Penna.): Committee X—Signaling Practice, presented a report yesterday showing the application of these various aspects, indications and names, and the name "Restricting Signal" was eliminated from the application, but this does not affect the information as shown in this chapter.

[Chairman Vallee then presented Chapter XI—A-C. Track Circuits.]

T. S. Stevens (A. T. & S. F.): The work of this committee is probably one of the most important things before us. Here we have something that we are using every day on the Santa Fe to find out what a maintainer knows. It forms a basis for selecting men.

Chairman Vallee: In one of the previous chapters an error was shown in one drawing, and revisions will be sent out.

J. E. Saunders (D. L. & W.): We issue copies of these chapters as our instruction pamphlets and require our men to treat them the same as they do the book of rules, bulletins and other instructions. We do not require our men to have a detailed technical knowledge, but only a fair working knowledge. We offer the man an opportunity to purchase an additional copy if he wants one for his own personal property. One of our maintainers detected the error that Mr. Vallee mentioned.

J. J. Corcoran (N. Y. C.): In the table on Impedance of Bonded Rails to Signal Currents, 27.5-ft. rails are listed. Why not show the 39-ft. rail which is now in general use?

Mr. Vallee: The committee will consider the suggestions offered by Mr. Corcoran.

Personnel of the Committee on Instructions

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C. E. Earhart, supvr. sigs., I. C., Vicksburg, Miss.
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A. L. Shepard, sig. inspr., N. Y. C. & St. L., Cleveland Ohio.
W. H. Stilwell, sig. engr., L. & N., Louisville, Ky.
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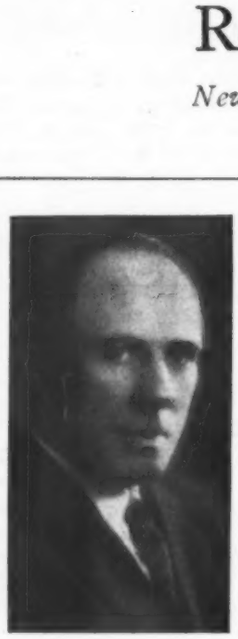
G. K. Thomas, asst. sig. engr., Sys., A. T. & S. F., Topeka, Kan.
G. A. Washburn, gen. sig. inspr., C. & O., Richmond, Va.

Report on Standard Designs

New schedule for electric lamps suggested and drawing of pins revised for forced lubrication



A. H. McKeen
Chairman

EIGHT revised standard drawings, and six new standard drawings covering the application of color-light signals, as well as the removal of eight obsolete standard drawings, constituted the work of the Committee on Designs. For the most part, the revised drawings covered equipment details, revisions of which were necessary because of recent changes in practice. A good example of the efforts of the committee in this direction is afforded by its revision of the standard drawing covering crank and jaw pins which was changed to permit the application of pressure lubrication fittings. The exact locations of the holes which are drilled in the pins to accommodate the lubrication fittings, and also the grooves which must be machined in the pins for the purpose of diffusing the lubricant, were clearly indicated on the revised standard plan.

In line with the most recent developments in manufacture, the committee revised its drawing of the incandescent electric lamp and adapter to show the latest design of filament construction, and also to include the most recent schedule of lamp sizes and capacities. Most of the drawings to be made obsolete, referred to details of pole line construction. Three of the new drawings related to signal masts for light signals, two of them covered ladders and platform parts for light signals, while another drawing covered the application of color-light signal units to a signal mast.

Revised Drawings Submitted

A. R. A. Sig. Sec. 1010C—Crank and Jaw Pins. Revised to show pressure lubrication.

A. R. A. Sig. Sec. 1056B—Terminal Blocks—Details and Assembly. Revised to show glazed and unglazed surfaces.

A. R. A. Sig. Sec. 1070C—Binding Posts—Details and Assembly. Revised to show assemblies 10705; 107010; 107015 and removal of 10702 binding nut.

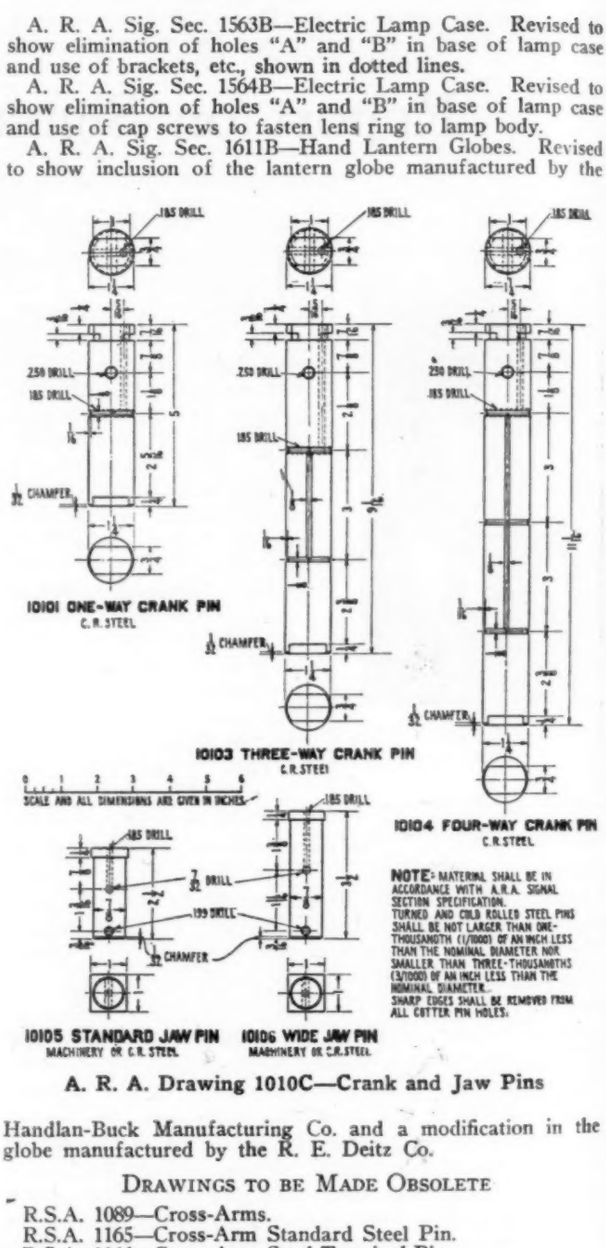
A. R. A. Sig. Sec. 1095B—Details and Assembly of Multiple Unit Bolt Lock. Revised to show addition of special nut 109515.

A. R. A. Sig. Sec. 1544B—Incandescent Electric Lamps and Adapter. Revised to show new design of filament and lamp schedule.

A. R. A. Sig. Sec. 1563B—Electric Lamp Case. Revised to show elimination of holes "A" and "B" in base of lamp case and use of brackets, etc., shown in dotted lines.

A. R. A. Sig. Sec. 1564B—Electric Lamp Case. Revised to show elimination of holes "A" and "B" in base of lamp case and use of cap screws to fasten lens ring to lamp body.

A. R. A. Sig. Sec. 1611B—Hand Lantern Globes. Revised to show inclusion of the lantern globe manufactured by the


10101 ONE-WAY CRANK PIN
C.R. STEEL
10103 THREE-WAY CRANK PIN
C.R. STEEL
10104 FOUR-WAY CRANK PIN
C.R. STEEL
SCALE AND ALL DIMENSIONS ARE GIVEN IN INCHES
NOTE: MATERIAL SHALL BE IN ACCORDANCE WITH A.R.A. SIGNAL SECTION SPECIFICATION.
TURNED AND COLD ROLLED STEEL PINS SHALL BE NOT LARGER THAN ONE-THOUSANDTH (1/1000) OF AN INCH LESS THAN THE NOMINAL DIAMETER NOR SMALLER THAN THREE-THOUSANDTHS (3/1000) OF AN INCH LESS THAN THE NOMINAL DIAMETER.
SHARP EDGES SHALL BE REMOVED FROM ALL COTTER PIN HOLES.
10105 STANDARD JAW PIN
MACHINERY OR C.R. STEEL
10106 WIDE JAW PIN
MACHINERY OR C.R. STEEL

A. R. A. Drawing 1010C—Crank and Jaw Pins

Handlan-Buck Manufacturing Co. and a modification in the globe manufactured by the R. E. Deitz Co.

Drawings to be Made Obsolete

R.S.A. 1089—Cross-Arms.
R.S.A. 1165—Cross-Arm Standard Steel Pin.
R.S.A. 1166—Cross-Arm Steel Terminal Pin.
R.S.A. 1167—Cross-Arm Pin Cap Gage (Hardened Steel).
R.S.A. 1129—Cross-Arm Brace.
Drawing 1220—Cross-Arm Bolts—Galvanized (Through and Spacing).
R.S.A. 1344—Knife Switches and Clips—Details.

Personnel of the Committee on Designs

A. H. McKeen, system sig. engr., U. P., Omaha, Neb.
Chairman

F. H. Bagley, sig. engr., S. A. L., Savannah, Ga.
P. M. Gault, sig. engr., M. P., St. Louis, Mo.
C. J. Kelloway, supt. sig., A. C. L., Wilmington, N. C.
J. C. Mock, sig. & elec. engr., M. C., Detroit, Mich.
C. H. Morrison, sig. engr., N. Y. N. H. & H., New Haven, Conn.
H. H. Orr, supt. sigs. & tel., C. & E. I., Danville, Ill.

C. A. Christofferson, sig. engr., N. P., St. Paul, Minn.
Vice-chairman

G. K. Thomas, asst. sig. engr., Sys., A. T. & S. F., Topeka, Kan.
Vice-chairman

E. K. Post, sig. engr., Pennsylvania, Philadelphia, Pa.
W. M. Punter, sig. engr., C. N., Montreal, Que.
H. L. Stanton, engr. tel. & sigs., Pennsylvania, Chicago.
L. Wyant, sig. engr., C. R. I. & P., Chicago.

R.S.A. 1345—Single Throw Switches (Charging Panels, 250 Volts or Less).

NEW DRAWINGS

A.R.A. Sig. Sec. 1616A—Light Signal Masts.
A.R.A. Sig. Sec. 1617A—Light Signal Masts.
A.R.A. Sig. Sec. 1618A—Light Signal Masts.
A.R.A. Sig. Sec. 1619A—Ladders and Platform Parts for Light Signal Masts (Details and Assembly).
A.R.A. Sig. Sec. 1620A—Ladders for Light Signal Masts (Assembly).
A.R.A Sig. Sec. 1621A—Application of Light Signal Units to Masts.

The revised as well as the new drawings were submitted for acceptance for submission to letter ballot and the same action was recommended concerning the removal of the obsolete drawings from the Manual.

Discussion

[The report of the Committee on Designs was presented by Chairman A. H. McKeen (U. P.), who submitted the drawings as listed in the report. The chairman explained the changes to be made and, after a brief discussion of each drawing, a motion that it be *submitted to letter ballot was carried in each case.*]

Signal Section Registration

THE registration yesterday at the convention of the Signal Section, A. R. A., at the Stevens hotel was 75 members and 9 guests, bringing the total attendance for the two days to 609, of whom 537 were members and 72 were guests. This compares with an attendance of 609 members and 79 guests, or a combined total of 687 in attendance at the convention last year.

A

Abernathy, H. D., chf. sig. inspr., N. Y. C., West, Cleveland, O.
Anderson, A. S., vice-pres., Adams & Westlake Co., Chicago.
Anderson, J. C., constr. engr., National Railway Signal Co., Chicago.
Ashford, S. D., sr. sig. engr., I. C. C., Washington, D. C.

B

Barton, E. D., asst. sig. supvr., C. M. St. P. & P., Winona, Minn.
Biggers, C. W., gen. for., C. & N. W., Chicago.

C

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Crowley, T. J., vice-pres. sales, Handlan-Buck Manufacturing Co., New York City.

D

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Dawson, W. A., sig. supvr., N. Y. C., West, Ashtabula, O.
Deems, E. M., vice-pres. & treas., Railroad Accessories Corp., New York City.
Derr, W. T., chf. sig. draftsman, N. Y. C. & St. L., Cleveland, O.

E

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Finch, J. C., sig. inspr., M. P., St. Louis, Mo.

G

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Gort, G., vice-pres. & sales mgr., L. S. Brach Manufacturing Co., Newark, N. J.

H

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Hayes, S. W., pres., Hayes Track Appliance Co., Richmond, Ind.
Hesler, I. D., sig. inspr., C. C. C. & St. L., Hillsboro, Ill.
Hodgdon, C. R., sig. engr., Can. Pac., West, Winnipeg, Man., Can.
Hoffman, J. C., sig. supvr., B. & O., Akron, O.
Hofmann, S. C., supvr. sigs., I. C., Champaign, Ill.
Hull, S. P., sig. supvr., N. Y. C., East, New York City.

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Jensen, O. M., asst. sig. supvr., C. M. St. P. & P., Milwaukee, Wis.

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Kettlesen, E. W., sig. draftsman, M. P., St. Louis, Mo.
Kies, Curtis, gen. sig. inspr., C. & A., Bloomington, Ill.
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Kyle, W. T., gen. mgr. sales, Page Steel & Wire Co., Bridgeport, Conn.

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Lightfoot, L. L., asst. sig. supvr., N. Y. C., West, Toledo, O.
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Millison, D. J., sig. inspr., Penna., Chicago.
Mock, H. F., sig. supvr., C. & N. W., Green Bay, Wis.
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O

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P

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R

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Rudd, W. B., engr., Union Switch & Signal Co., Swissvale, Pa.

S

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Selke, F. A., sig. supvr., C. I. & L., Lafayette, Ind.
Sheckler, L. I., supvr. tel. & sigs., C. G. W., Mason City, Ia.
Sicht, J., sig. supvr., M. P., Little Rock, Ark.
Skinner, Ivan, engr. acct., M. P., St. Louis, Mo.
Smith, B. F., gen. sig. supvr., A. T. & S. F., Topeka, Kans.
Starkweather, F. E., elec. engr., P. M., Detroit, Mich.
Stilwell, W. H., sig. engr., L. & N., Louisville, Ky.
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T

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Troth, R. W., chf. draftsman, St. L.-S. F., Springfield, Mo.

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W

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Waltz, E. L., supvr. tel. & sigs., C. G. W., St. Paul, Minn.
Weigel, J. B., sales engr., R. R. Materials Div., Ohio Brass Co., Mansfield, O.
Wilson, E. C., first vice-pres., National Railway Signal Co., Boston, Mass.

Guests

Caviston, J. C., supt., Operating Division, A. R. A.
Downing, F. E., elec. engr., Rome Wire Co., Chicago.
Hughes, Homer, engr. insp., Michigan Public Utilities Commission, Lansing, Mich.
Jones, Fred H., dist. sales mgr., Page Steel & Wire Co., Pittsburgh, Pa.
Mayes, H. J., sales mgr., Hayes Track Appliance Co., Richmond, Ind.
Notgrass, C. D., trainmaster, A. T. & S. F., Chanute, Kans.
Rees, T. E., dealer, Chicago.
W. J. Savage, sales engr., Thos. A. Edison, Inc., Bloomfield, N. J.
Wayt, G. M., Wayt & Son, Ludington, Mich.

H. W. Lewis Elected Chairman of the Signal Section, A. R. A.

Various sections of the United States and Canada represented on new Committee of Direction

H. W. LEWIS, signal engineer of the Lehigh Valley, with headquarters at Bethlehem, Pa., was elected chairman of the Signal Section, A.R.A., according to the announcement of the secretary, H. S. Balliet, at the close of the annual convention yesterday. The other officers elected include: first vice-chairman, P. M. Gault, signal engineer, Missouri Pacific, St. Louis, Mo., second vice-chairman, A. H. Rice, signal engineer, Delaware & Hudson, Albany, N. Y., and secretary, H. S. Balliet, special engineer, New York Central, New York (re-elected).

The Committee of Direction now includes, in addition to the chairman, first vice-chairman and second vice-chairman, F. J. Ackerman, signal engineer, Kansas City Terminal; R. B. Elsworth, assistant signal engineer, New York Central; W. F. Zane, signal engineer, Chicago, Burlington & Quincy; C. H. Tillett, signal engineer, Canadian National; F. W. Bender, signal engineer, Central R. R. of New Jersey; H. G. Morgan, signal engineer, Illinois Central; H. H. Orr, superintendent of signals and telegraph, Chicago & Eastern Illinois; A. H. McKeen, system signal engineer, Union Pacific System; A. H. Rice, signal engineer and superintendent of telegraph, Delaware & Hudson; W. E. Boland, signal engineer, Southern Pacific; A. B. Himes, first assistant signal engineer, Baltimore & Ohio, and W. F. Follett, assistant signal engineer, New York, New Haven & Hartford.

H. W. Lewis
Chairman

P. M. Gault
First Vice-Chairman

A. H. Rice
Second Vice-Chairman

H. S. Balliet
Secretary

Harry W. Lewis

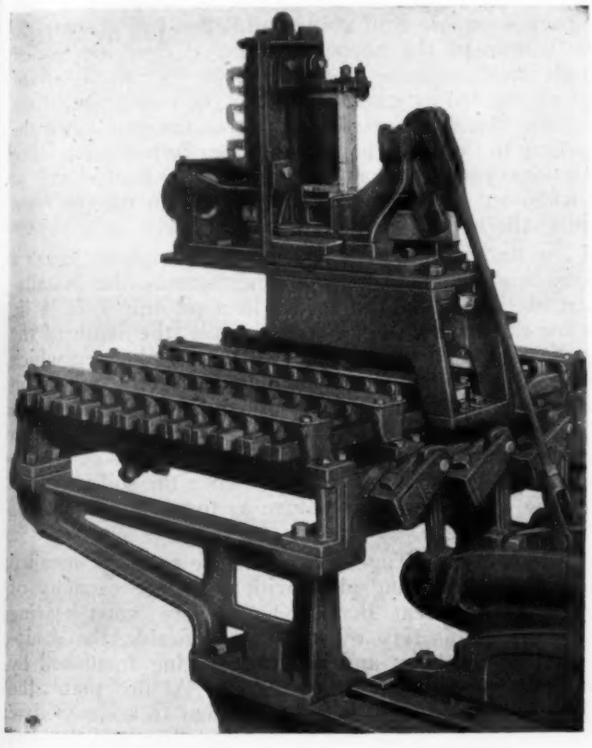
Harry W. Lewis is well known in the signaling field, having attended every annual convention for a number of years, with the single exception of 1928, at which time he was seriously ill. He has been an active member of several committees of the Signal Section, including those on Overhead and Underground Lines; Highway Crossing Protection; and the Committee of Direction. He is now chairman of the Committee on Committee Assignments.

Harry W. Lewis was born on April 4, 1868, at Gwynedd, Montgomery County, Pa. He was educated at the North Wales Academy and School of Business. He first entered railway service as an assistant towerman on the Philadelphia & Reading in 1884, and was employed by this road for about 10 years as towerman, telegraph operator and station agent. In January, 1894, Mr. Lewis entered the service of the New York Life Insurance Company as a special agent, but six months later he returned to railroad work as an operator for the Lehigh Valley, being appointed a signal inspector in May, 1895, and being promoted to division signal inspector five years later. In March, 1902, Mr. Lewis was appointed signal supervisor on the New Jersey and Lehigh division with headquarters at Easton, Pa., and in October, 1906, he was promoted to signal engineer of the Lehigh Valley, which position he now holds.

Mr. Lewis has contributed liberally of his time and talents to the betterment of the schools in his home town of Bethlehem, Pa. For several years he was chairman of the school board in which capacity he was instrumental in carrying through the construction program for the new Liberty high school with all the modern equipment of a play ground, a gymnasium, swimming pool and an auditorium. In this auditorium recitals are given by the famous Bach choir of which J. F. Wolle is director. Mr. Lewis enjoys outdoor life and has a cottage in the Pocono mountains, near Bethlehem, where he goes frequently on week-ends for rest and recreation.

Forced-Drop Electric Lock

THE Union Switch & Signal Company has recently developed a new forced-drop electric lock, known as the Style-ML type. This lock has been arranged for mounting in a number of different ways: above or below the locking bed of an I. S. & F. mechanical machine; above the locking bed of either the Style-A or the dwarf-type machine; and for the S-8 electro-mechanical machine. Many locking possibilities are provided by the Style-ML forced-drop electric lock. It may be arranged for locking a latch "up normal," "normal," latch "up reverse," "reverse" or any combination or multiple of these. One



Style-ML Forced Drop Electric Lock Applied to Mechanical Machine

lock arrangement may be changed to a different combination, by changing the lock and depressor plates of the lock bar, without sacrificing the forced-drop feature for any one of the various locking positions.

The unlock magnet is an adaptation of the Model-13 indication magnet, used on the Union power interlocking machines. The armature of this magnet operates the locking dog that accomplishes the locking. When the cover of the lock is removed everything is accessible for hand operation or for replacement of parts. Large clearances and complete freedom of motion of the parts in this magnetic system have been maintained. The lock bar is driven directly from the rocker link of the machine through a crank on the lock. This is done without gears and thus lost motion is reduced to a minimum. Compensation is provided in the crank to take care of variations in rocker link motion.

A six-contact circuit controller is provided on the lock. The contacts are of the relay contact finger type and move horizontally, thus providing self-cleaned vertical openings. The contacts are driven by individually adjusted cams mounted on a vertically pivoted shaft that is operated through a crank directly from the lock bar. The arrangement of this crank and its connection to the lock bar permit a fine adjustment of the contacts as related to the motion of the lever latch rod.

Auxiliary controller units having 6, 12 and 18 contacts can be provided with this lock when it is applied below the locking bed of the machine. These units are to be mounted below the lock and are operated from the same crank that operates the main circuit controller. When desired, a separate emergency hand release may be provided which may be sealed to prevent unauthorized operation.

A New Model Section Car

FAIRBANKS, MORSE & COMPANY, Chicago, has announced a new model section motor car, designated No. 44B, which supersedes its No. 44 car, which has been on the market for some time. The new car has a number of distinctive features, the most prominent of which is the unusually large deck space provided for tools, this space being approximately 22 sq. ft. in area. Another distinctive feature of the car is the operator's seat which is provided at one side.

The new car, which has a frame of heavy pressed steel, is equipped with a single-cylinder two-cycle engine. This engine is water-cooled, but in addition the cylinder head is air-cooled. It is claimed that this latter feature reduces the evaporation of water in the water hopper, making possible greater mileage without refilling the hopper. It is said that this feature also improves the starting quality of the motor in cold weather.

The crankshaft of the No. 44B runs in Timken tapered bearings, and the drive is by a roller chain from the sprocket on the crankshaft to the sprocket on the rear axle. The drive is controlled by means of

The New 44B Has 22 Sq. Ft. of Tool Space

a special clutch, which, it is said, can be slipped without damage or burning in starting heavy loads, or when the car is operating over severe grades. On actual test, the clutch of one of these cars has been slipped continuously for eight hours, absorbing full load, without burning or damage to any of its parts.

The rear axle of the new car is of special design, being $2\frac{7}{16}$ in. in diameter at the center and tapered towards the bearings. This special feature of design takes care of all strains on the axle without the necessity of a center steady bearing. The side bearings of the axle consist of a double row of Timken tapered bearings mounted in bearing boxes of special design.

Trunnionless Relays

THE Union Switch & Signal Company recently placed on the market a trunnionless relay intended for track and line use. The size, operating characteristics, and general construction of this relay are the same as the Union Style-DN 11, but the

Union Style-DN12 Trunnionless Relay

armature suspension is arranged with vertical flat springs instead of with trunnions. Being trunnionless any tendency toward corrosion of the trunnions is eliminated and there is freedom from wear due to the elimination of moving parts.

This relay is compact, being 6¼ in. square and 8 1/16 in. in height. The base structure has a metal bottom and plate glass sides, although when desired, a base of moulded glass can be furnished.

The V-type graphite and flat-spring finger-contacts used in this relay provide a contact system that eliminates the possibility of pitting as well as distortion. The Union trunnionless relay is manufactured with 4, 6, 8 and 10 front contacts. The four-ohm, four-point relay will give full contact pressure on a working current of 70 m.a., will pick up at 65 m.a. and will release at 37 m.a.

Shallow-Pit Coaling Plants

AN improved method of loading buckets in shallow-pit coaling plants has been developed by the Roberts & Schaefer Company, Chicago, whereby all triggers, latches and trippers have been eliminated and the gate of the hopper is operated by the movement of the bucket itself, which is guided to its proper position by a change in level of the track on which the bucket descends into the pit. As the bucket comes to place under the hopper, it engages lugs attached to an under-cut gate at the bottom of the hopper and rolls it back on angle iron guides until the full aperture in the bottom of the hopper is exposed over the bucket in its final position. As the bucket is raised out of the pit, the loader gate is closed by the movement of the bucket, which disengages itself from the gate when the opening in the track hopper has been fully closed. The relations between the bucket and the loader are so worked out as to prevent spilling coal in the pit from either the hopper gate or the bucket.

The design of the shallow-pit coaling plants saves a large amount of excavation and permits the installation of the bucket and feeder in a pit only 7 ft. 4 in. below the opening in the track hopper, the depth of the hopper itself varying with the length of hopper which must be provided to accommodate the type of car in which the coal is delivered, and the slopes required to make the hopper self-clearing. This feature, which saves a large amount of excavation, is always of advantage, but is particularly valuable when the soil is water-bearing or is of such a nature as to make the cost of excavation high.

The Atchison, Topeka & Santa Fe recently installed a shallow-pit coaling plant with a storage capacity of 300 tons at Great Bend, Kan., where water-bearing sand made this type of structure desirable, the equipment for the hoist and pit loader being furnished by the Roberts & Schaefer Company. At this plant, the track hopper is 40 ft. long in the clear to accommodate the full length of the car at one dumping, and the coal is elevated in a two-ton bucket at the rate of 60 tons per hour. A 50-ton gravity sanding plant is located alongside the coaling plant and the wet sand is elevated from the track hopper in the coal bucket, being diverted to the wet sand storage bin through a circular steel chute.

The Track Hopper Gate in Open and Closed Positions